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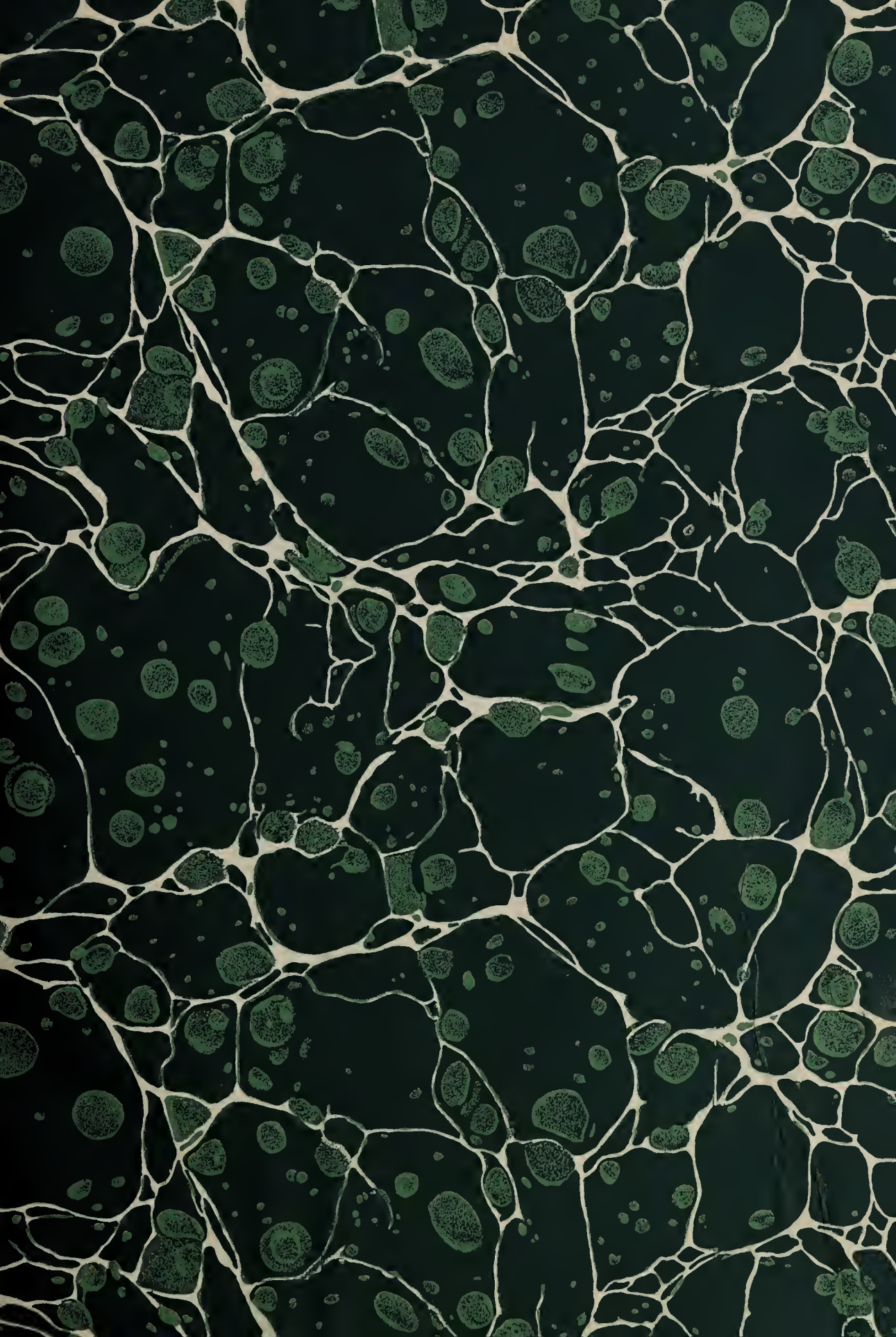
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THE
GARDENER'S ASSISTANT.

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Drawn by J. P. W. Rogers

Engraved by W. Smith

1 *Lilium lancifolium album* 2 *Lilium lancifolium roseum*



THE
GARDENER'S ASSISTANT:

PRACTICAL AND SCIENTIFIC.

A GUIDE

TO THE FORMATION AND MANAGEMENT OF THE
KITCHEN, FRUIT, AND FLOWER GARDEN,

AND

THE CULTIVATION OF CONSERVATORY, GREEN-HOUSE, AND HOT-HOUSE PLANTS.

WITH A COPIOUS CALENDAR OF GARDENING OPERATIONS.

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HORTICULTURAL SOCIETY, AND OF THE ROYAL COMMISSION OF POMOLOGY OF BELGIUM.



BLACKIE AND SON:

FREDERICK STREET, GLASGOW; SOUTH COLLEGE STREET, EDINBURGH;
AND WARWICK SQUARE, LONDON.

PREFACE.

IN the following Work, the Author has endeavoured to describe fully, and he trusts clearly, the principal operations which have to be performed in Gardens.

Before entering upon the practical portion of the Work, such explanations are given respecting the nature and functions of the Organs of Plants, the substances which constitute the Food of Plants, and the manner in which they are taken up and assimilated, as seemed needful to enable the reader fully to comprehend the principles by which cultivation is regulated. A knowledge of Soils being of great importance to cultivators, descriptions and analyses of the different kinds are given, the processes described by which their more important properties may be determined, and the means pointed out which may be employed for their improvement. The adaptation of Manures to the nature of the soil, and the most advantageous modes of applying them, are likewise entered into at some length.

Thus far the Work relates to the nature of Plants, and the materials from which they derive their support; but before passing to the operations connected with their culture, the tools, instruments, and machines which have to be employed in such operations are described, and the properties which they should possess, to insure the greatest efficiency, explained.

Proceeding to the formation of the Fruit and Kitchen Garden, the situation, soil, and extent of Gardens of that description are taken into consideration. As ground operations are liable to be badly executed, and rendered unnecessarily expensive, in consequence of persons working without system, and almost by chance, this serious evil is attempted to be obviated by explaining the principles of levelling with reference to the most economical modes of performing such pieces of labour.

Full information respecting the different varieties of Vegetables being considered a desideratum by many persons, the Author has endeavoured to supply this want, by giving descriptions of the best ascertained sorts, so as to admit of selections being made that can be depended on, whilst sorts that are reputed to be new and superior are under trial. At the same time, it is hoped that both the amateur and the qualified gardener will derive assistance from the instructions given for the management of Kitchen Garden crops, and that the art of Propagation will be rendered more easy of comprehension from its principles being explained, and the operations involved in it particularly detailed; for, even with the greatest possible care, errors are frequently committed through defective knowledge of these principles.

Pruning and Training are common operations; yet it must be admitted that they are too often conducted on erroneous principles, and an incalculable amount of damage is the consequence. It is by no means unusual to see garden walls, for example, disfigured by miserable specimens of trees, exhibiting only the lingering remains of vegetation, their natural vigour having disappeared under improper treatment. That better results may be insured, while defective modes are pointed out, great pains have been taken to explain the true principles on which pruning

and training should be conducted, which, if carefully studied and judiciously acted upon, cannot fail to prove highly advantageous.

The special culture of the various classes of Fruits is taken up at considerable length ; and descriptions of upwards of 460 of the more select kinds are given with sufficient copiousness to enable any one to form a tolerably correct idea of the properties of the respective sorts ; and that being once acquired, the difficulty of making a selection likely to prove satisfactory will be greatly obviated.

In treating of Garden Structures, a plan of building hollow walls, for which the Author is indebted to Mr. Joseph Sibthorp, of Turnham Green, deserves notice, from being much superior to the modes generally adopted. The principles of Heating are also explained, with the view of introducing systems combining the greatest effect with the utmost simplicity. In the section on Forcing, the natural climates of the principal fruits and vegetables have been made subjects of careful investigation, in the belief that useful reference may be made to the results. The succeeding chapter is occupied with the laying out and management of the Flower Garden and Pleasure Grounds, and lists of the most Ornamental Trees, as well as short descriptions of the principal Hardy Shrubs. The most important points in the treatment of Herbaceous Plants, Hardy Bulbs, Annuals, and Bedding Plants, are noticed, and the culture of the principal Florists' Flowers is detailed at considerable length.

The objects of cultivation in the Greenhouse, Conservatory, and Stove, being too numerous for each one to be separately noticed within the limits of this Work, remarks are made on the general treatment of the plants grown in these structures, and the particular culture of some of the most popular is described.

In conclusion, the Author has to acknowledge his deep obligations to the following gentlemen for the kind assistance which they have afforded during the progress of the work—namely, to Mr. William Paul, of the Cheshunt Nurseries, whose eminence as an enlightened horticulturist is well known, and whose high authority on all matters connected with the Rose and Hollyhock is unquestionable, for the revision of the articles on those subjects ; to Mr. Cock, of Chiswick, who has achieved such great successes in the culture of the Pelargonium, for a similar favour with regard to the article on that plant ; to Mr. Salter, of the Versailles Nursery, Hammersmith, whose great skill in the improvement and culture of the Chrysanthemum is well known, for his kindness in correcting the article on that flower ; and for the revision of the article on Cape Heaths, to Mr. Glendinning, of the Chiswick Nursery, whose magnificent collection of heaths is the best testimony of the skill with which it is managed. To each of these gentlemen the Author begs to tender his most sincere thanks.

R. T.

CHISWICK, *September*, 1859.

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CALENDAR OF GARDEN OPERATIONS.

SEVERAL works on Gardening have been written in the form of a Calendar, and, from their popularity, it may be inferred that information in that way is required by many persons. It has been thought advisable to commence this Work with a CALENDAR OF OPERATIONS, not only for the above reason, but also because a Calendar, from its nature, requires to be frequently consulted, rather than to be consecutively perused; and by placing it at the beginning, reference can be made to it with greater facility than if it were introduced elsewhere in the Work.

It is necessary to observe, that no calendarial directions can be made to justify the expectation that they can be strictly followed in all cases. The climate of the locality, the season, soil, or other circumstances, render deviation expedient, or absolutely necessary. It will be found, however, that in making out the following Calendar, most circumstances occasioning exceptions to the general rule have been noticed, and suitable directions given accordingly. It would be almost impossible to provide for every contingency; but any intelligent person will easily adopt such modifications as his particular case may require. On the whole, it is presumed that the following Calendar will be generally applicable throughout the United Kingdom. It may be said that over this extent the climate is exceedingly variable, and therefore no one Calendar could be applicable; but, within certain limits of elevation, the difference between the temperatures of any two places is much less than frequently occurs between the temperatures of two different seasons at the same place. For example, if we take March—the principal spring month for seed-sowing—we find that, over nearly ten degrees of latitude, extending from Paris to Wick, in Caithness, the mean temperature of that month differs very little, on the average of a number of years, as will be seen by the following table:—

	Latitude.	Mean Temperature of March.
Paris	48° 50'	43°79
Rouen	49 26	41°12
Brussels	50 51	42°78
Chiswick (London)	51 29	42°23
Boston (Lincolnshire)	52 48	41°67
Dublin	53 21	42°46
Liverpool	53 25	44°44
Edinburgh	55 58	40°53
Dundee	56 27	42°20
Aberdeen	57 9	42°80
Elgin	57 38	40°53
Wick	58 29	41°94

From the above, it appears that the mean temperature of March is nearly the same at Chiswick, Dublin, Dundee, and Aberdeen, although the last-named of these places is nearly 400 miles north of the first. At Elgin the month of March is just

as warm as it is at Edinburgh, and at Wick the mean temperature at that period of the season is higher than at Edinburgh. It will also be seen that, at all the above places, the difference of temperature in March is not such as to affect materially the CALENDAR OF OPERATIONS. In fact, its scope may include all those widely distant places.

But in different seasons, at the same place, a greater variation than that arising from latitude frequently occurs, in consequence of which considerable modifications of usually applicable directions have to be made. The mean temperature of the month to which we have referred, varies as much as ten degrees in different years; and operations, such as sowing and planting, which, in ordinary seasons, would be properly done in the first week of March, may not be at all practicable, in consequence of frost and snow, till the very end of the month. For instance, in March, 1845, seeds that ought to have been sown in the commencement of the month, could not be sown till the end, even near London, for in the third week the ground was there frozen to the depth of seven or eight inches.

The above facts plainly show that the adaptation of a Calendar is more affected by the variations of the seasons, than by any circumstance connected with localities fit for gardens throughout the extent of Britain. If, therefore, a Calendar be carefully made for one place, it may be considered proper for this country in general. By persons in the south, as well as in the north, calendarial directions must be understood with the proviso—*weather and state of the soil permitting*. If these are favourable, the earliest opportunity should not be neglected to carry out the operations as indicated.

JANUARY

County	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall ..	Penzance ..	50° 7'	5° 33' W.	42·62	2·90	21
Middlesex..	Chiswick ...	51 29	0 18 W.	36·94	1·69	30
Gloucester..	Stroud	51 45	2 13 W.	36·10	2·77	30
Lincoln.....	Boston	52 48	0 5 W.	35·97	1·63	20
Dublin	Dublin	53 21	6 11 W.	39·23	...	17
Lancashire ..	Liverpool..	53 25	2 59 W.	39·95	...	25
Dumfries ..	Applegarth	55 13	3 12 W.	34·06	2·57	19
Mid-Loth..	Edinburgh	55 58	3 11 W.	37·00	2·12	20
Aberdeen ..	Aberdeen..	57 9	2 5 W.	37·82	...	8
Orkney.....	Sandwick..	59 5	3 17 W.	38·60	4·21	26

I.—KITCHEN GARDEN DEPARTMENT.

If the weather prove frosty, take the opportunity of wheeling manure to quarters where it will be required, taking care, however, to put it together in a compact heap, if it cannot be immediately used. Trenching should be carried on, but on no account should masses of frozen soil be buried, as they are long in thawing, and whilst this is taking place, and for a considerable time afterwards, the soil is kept in a cold, saturated condition, which

renders it most unfavourable to vegetation. Clear off all vegetables that may have been killed by frost as soon as their condition is evident. When the state of the soil will permit, stir the surface between crops. Small three-pronged drags are useful for this purpose.

Artichokes.—Give additional protection if the weather is likely to prove severe, so as to prevent the ground from freezing about the roots; and some dry leaves or litter should be put over the hearts of the plants.

Asparagus should have a good thickness of manure put on the beds, if they have not already been attended to in this respect. Sea-weed, and a mixture of cow and horse dung, may be employed. After being laid on, the manure should be slightly covered with fine soil.

Beans.—Sow, in a warm situation, Early Mazagan, or Marshall's Dwarf Prolife; and some may be sown in pots for transplanting. Towards the end of the month, make a sowing of the Long-pod.

Broccoli.—Take up such as are fit, or nearly fit for use, and place in a cellar. If the weather is likely to be severe, those of which the heads have just commenced to form should be taken up with a ball and likewise housed.

Cabbages.—Plant out from the seed-beds some of the largest plants of the Early York. Sow a little of the Vanack on a border, or in a cold frame.

Cardoons.—Those that are fully grown may be taken up with balls, and planted among sand in a shed or cellar, where they can be protected from frost, taking care to visit them frequently, in order to remove all decaying leaves.

Carrots.—Sow a few Early Horn on a south border. Examine those stored up, and remove any that are proving unsound; take off young growths, if any are being made.

Cauliflowers.—Take up and house those fit for use. Sow a little in gentle heat. When the state of the weather will permit, give always plenty of air to plants under glass, in whatever stage of growth they may be. Put mats or litter over the glass when the frost is severe.

Celery.—Sow a little in pans, in moderate heat under glass, for early use. Protect that in ridges with hoops and mats; or litter, fern, or dry turf may be placed, sloping at the top of the ridge, close to the plants. Such of the latter as are completely blanched will suffer most from frost, and it will, therefore, be advisable to take up some rows and plant them in a cellar or shed, taking care that the leaves are tied up so as not to be broken in the operation. Earth up the latest crop when the weather permits.

Endive.—Tie up, for blanching successively, in dry weather. Protect from frost. A quantity of the Curled Endive, and of the White-flowered Batavian or *Scarole*, may be taken up from the open ground and planted in sand, or dry sandy soil, in any dark place, where there is a temperature of between 55° and 60°.

Horse Radish.—Make new plantations. Dig up and put in sand, for a supply in case of hard frost.

Jerusalem Artichokes.—Some of these may be taken up and housed. Towards the end of the month, a new plantation may be made in any spare corner, where other kinds of vegetation will not be shaded by these tall-growing plants.

Lettuces.—Sow Green Paris Cos, White Paris Cos, and Brown Dutch, in a frame, or on a south border. In either case, means should be adopted to protect from frost, which is more especially to be guarded against at the time when the seeds are germinating; the ground in which the sowing is made should not then be allowed to get frozen. When the leaves are at any time a little frozen, care must be taken to prevent the sun's rays from acting upon them whilst they are in that state.

Give plenty of air in favourable weather to the young plants from the autumn sowing, in protecting frames. If the weather prove favourable towards the end of the month, a few of these may be planted out.

Onions.—Sow, in a warm border, or in a frame, some of the White Silver-skinned, for drawing for salads, and for transplanting.

Parsley.—Protect a portion from severe frost. Sow a little in a sheltered situation.

Pease.—Sow Early Frame, and Bishop's New Long-pod, in the beginning, and some of the Early Charlton may be sown at the end of the month. Sow likewise the Early Frame in small pots, to be protected under glass, in frames or elsewhere, for planting out. When the soil is tolerably dry, some earth should be drawn to those a little above ground; and they should be stuck rather closely for shelter, as well as for future support. Where leaves are plentiful, a layer of them may be placed close to the rows.

Potatoes.—Plant, in the driest ground, the Ash-leaved Kidney, or any other good early sort. The sets, at this season, should be placed 8 inches deep.

Radishes.—Sow under a south wall, or on any sheltered border sloping to the sun, covering with litter at night, and uncovering during the day, when the weather is not severe.

Spinach.—A few rows may be protected in case of severe frost. Remove decayed leaves. Towards the end of the month, a little round spinach may be sown between the rows of pease.

Turnips.—Sow a little of the Early Dutch and Early White Strap-leaf on a warm border.

II.—HARDY FRUIT DEPARTMENT.

The ground for plantations of fruit-trees should be prepared in autumn, for these trees are, generally speaking, best planted imme-

diately after the fall of the leaf; but if circumstances have prevented the preparation of the ground, this should be carried on when the weather permits.

If the subsoil is good, the ground should be loosened to the depth of 3 feet; if water rise so as to remain for any considerable length of time within that distance from the surface, means should be adopted for drawing it off; if there should be no possibility of doing this for want of fall, then, in trenching, soil, rubbish, stones, &c., may be put in the bottoms of the trenches, in order to raise the good soil to a higher level.

Plant apples, pears, plums, cherries, quinces, medlars, chestnuts, walnuts, mulberries, filberts, gooseberries, currants, raspberries, apricots, peaches, and nectarines.

Prune all the kinds of trees above-mentioned, but not when their branches are frozen. Cut back the limbs of old trees intended to be grafted, for if left till the sap is flowing, the bark dies back to a considerable extent below the wound, and canker is apt to ensue. Cut off the heads of stocks; those of the quince should be cut off early in the month.

Cut off grafts, especially those of plums and cherries, for if these are not taken off early, they seldom succeed well. After the grafts are cut off, put their ends in soil in a sheltered situation, where neither the sun's rays nor drying winds will directly affect them, till the grafting season arrives. Make cuttings of gooseberries and currants; they may be 9 inches or 1 foot in length, and all the eyes should be picked out, except three at top.

Clean and fork lightly the ground between the rows of strawberries; and then mulch with long dung, the nourishing principles of which will be carried down to the roots by the rain for the benefit of the crop; whilst the washed litter will serve to keep the fruit clean.

In bad weather, prepare new nails by putting them in boiling linseed oil, which will prevent them from rusting. Pick the shreds from nails that have been used, heat the nails to a red heat, and, when cooled a little below this, plunge them in linseed oil. All the shreds fit for being again used should be boiled, in order to destroy the eggs of insects.

III.—FORCING DEPARTMENT.

Asparagus.—Make fresh beds for succession.

Those in bearing should have a bottom heat of between 60° and 70°; the top heat should be about the same, but care should be taken that it do not exceed 75°. In order to give a green colour to the shoots, the sashes may be drawn up for a short time in very fine days, so that as many of the direct rays may be admitted as may be possible without lowering much the temperature. Add fresh linings, when necessary, so as to maintain the proper heat. As bearing plants become exhausted, they may be removed from pits or frames, and replaced by fresh plants, provided sufficient heat can still be kept up by linings, or otherwise.

Carrots.—Sow Early Horn on a slight hot-bed, where they can remain to draw in May.

Celery.—Sow, in gentle heat, a small quantity of the Early Dwarf White Solid for early use.

Chicory.—Introduce some plants of those previously potted to the mushroom-house, or other warm place where they can be kept dark.

Cress.—Sow successionaly in moderate heat.

Egg Plant.—Sow in small pots, and place in a heat of from 60° to 65°.

Endive.—Sow in a heat of from 60° to 65°.

Kidney Beans.—Sow in pots, half filled with rich soil, and place them anywhere in heat till they begin to push through the soil; they must then be placed in light, and as they grow the stems should be gradually earthed up till the soil nearly reach the edge of the pot. These plants must be frequently syringed, to prevent the attacks of red spider.

Lettuce.—Remove decaying leaves, and give air at all times when the state of the weather will permit. Some powdered charcoal, carefully introduced between the plants, will tend greatly to keep the air sweet, and, consequently, to prevent the rotting of the plants.

Mint.—Plant in pots or boxes, and introduce to heat.

Mushrooms.—Collect horse-droppings, free from litter, and keep them dry for succession beds, some of which should now be formed. Maintain in the mushroom-house a steady, rather moist temperature of between 55° and 60°; but that of the beds may range from 60° to 65°.

Mustard.—Sow successionaly in moderate heat.

Onions.—Sow in gentle heat, to draw for salading, also for transplanting.

Pease.—In the beginning of the month

sow in pots, and forward in gentle heat where plenty of air can be admitted.

Pennyroyal.—Plant in boxes, and place in heat.

Potatoes.—Plant some of the Ash-leaved Kidney, or any good early sort, in small pots, one set in each. The pots may then be piled together in any warm place, either light or dark, till the potato shoots are about to appear, when the plants should be turned out and planted on a slight hot-bed, 18 inches by 8 inches apart. Some may also be grown to maturity in pots.

Radishes.—Sow on slight hot-beds, in rows between those of carrots.

Rhubarb.—Cover some of the early kinds with pots, and these with hot dung and leaves. Also, take up some roots and place in heat.

Sea Kale.—Continue to force this in succession. Cover with pots or boxes, and take care that the materials do not heat too violently. This is apt to be the case when fresh stable manure is employed solely; it should therefore be mixed with a large proportion of leaves. Take up plants and place in soil, in the mushroom-house or elsewhere, so that they may be in heat, and kept from the light. The supply thus obtained will be more certain, in case of stormy weather, than that from forcing in the open ground.

Tarragon.—Plants of this, in pots, should be brought into heat.

Tomatoes.—If some of these are required early, sow in heat, for transplanting under glass, in February and March.

Cucumbers.—Where dung is intended to be the heating material, let it be frequently turned and thoroughly mixed, so that it may be of a proper and uniform moisture. If there be too much dry litter it should be watered, then trodden, or beaten with the fork, and afterwards shaken and distributed so as to be in contact with the shorter and naturally moister portions. A hot-bed should be prepared for the first crop; or, if that is already done, for a succession one. A heat of 75° should be kept up in the pits or frames in which plants are growing. Give air when the weather permits, and, if possible, so as to dry the foliage once a-day; but let it be given by degrees, never admitting a large draught suddenly. If the plants require water, let it be warmed to the temperature of the air of the frame.

Melons.—Prepare dung for beds by turning

and thoroughly mixing it, as directed for cucumbers. Sow early sorts in 3-inch pots, and place in a bottom heat of 75°, and a top heat of 70°. Plant, when the roots approach the sides of the pot, in a pit or frame where a bottom heat of 80°, and a top heat of 75°, can be afforded. Let the plants have as much sun-light as they can safely bear. Give air through perforated screens, or some open fabric, and, with this precaution, even in small quantity at night, especially if the sashes are close-glazed. Water in the early part of the forenoon, taking care that the heat of the water is equal to that of the air of the frame.

Pine Apples.—The *fruiting plants* should have a bottom heat of 80°, and a top heat of 70° at night, and 75° in the day, or, with sun-heat, 85°. Some, that it may be desirable to start early, should have a temperature of 75° at night, and from 80° to 85° in the day, or as high as 95° with sun-heat.

Succession plants require a lower temperature. For these the bottom heat should be from 70° to 75°, and the top heat 65° in the day, or 70° if the weather be clear.

Water sparingly, but take care that the soil do not get absolutely dry: it should always contain moisture for the roots, not merely at the top or by the sides of the pots, but throughout the mass. The water should be of a temperature as high as that of the air of the house. Give air, but in such a way as not to cause any material depression of temperature.

Vines.—In preparing to force these, let the house be cleared out and thoroughly cleaned. The rafters, sashes, and all except the glass, should be washed with hot water and soft soap. But the alkali of soap acts injuriously on the surface of glass; therefore, immediately after the sash-bars are cleaned, the glass should be well washed with tepid water. Clear off the loose bark from the vines; wash with soap and water, and paint with a mixture of soft soap, sulphur, and a little yellow loam, to give it the consistence of thick cream. The walls and flues should be whitewashed with lime, mixed with some flowers of sulphur. If the vines are outside, the border should be heated by some fermenting material. Protect the exposed portion of the stems. If planted inside, a quantity of stable dung may be allowed to ferment in the interior of the house. Commence with a tem-

perature of 45° at night, and 50° in the day, or 60° by sun-heat. Increase the heat gradually to 50° at night, and 60° in the day, when the buds are swelling. If, in an earlier house, the vines are in leaf, let the temperature be 55° at night, and from 65° to 70° in the day, or 80° with sun-heat. When showing flower, the temperature should be 65° at night, and 70° in the day, or with sun-heat 80°. Muscats require a higher temperature for setting, as well as for their future growth. When in flower, they should have a temperature of 70° at night, and from 80° to 85° in the day. Bend the shoots gently where buds are required to break. If a shoot break strongly at top, but imperfectly lower down, depress the upper part of the shoot. Maintain a moist atmosphere in the house, and, in syringing, use water about the same temperature as that of the air in the house at the time, but not higher. Stop the shoots of those so far advanced as to require it, at one or two joints above the bunch. Remove superabundant bunches, and commence thinning the berries at an early stage of their growth.

Figs.—Commence forcing with a temperature of 50° at night, and 60° by day with sun-heat; increase the temperature gradually in two or three weeks to 60° at night, and 65° in the day. Take care that the plants are never dry at the roots, for, after being once too dry, the young fruit is apt to turn yellow and drop. But whilst dryness is guarded against, sufficient drainage should, at the same time, be insured, so that the plants may not suffer from stagnant moisture.

Peaches and Nectarines.—Abundance of air should be given; but, at the same time, cold currents of it should be avoided. As the trees naturally blossom at a cool period of the season, they cannot with safety be subjected, at that stage of their vegetation, to a high temperature. Begin at 45° by night, and 55° by day, or 60° with sun-heat. When in flower, the temperature may be raised to between 50° and 55° at night, and 65° in the day, or 70° by sun-heat. Disbud very sparingly, at first removing some of the strongest superfluous shoots from the upper part of the branches. Look out for green fly, and fumigate on its very first appearance, or the foliage may be moistened with the syringe, and sprinkled with powdered tobacco leaves, or snuff made from genuine tobacco.

Cherries.—Commence to give a little fire-

heat, with plenty of air. A temperature of 45° at night, and 55° in the day, or 65° by sun heat, will be sufficient. When in blossom, increase to 50° by night, and 65° by day.

Strawberries.—Introduce to a temperature of 45° at night, and 60° by day. If the pots can have a bottom heat of from 60° to 65°, it will encourage the formation of an abundance of roots, where these are found to be deficient. After the fruit is set, increase the temperature to 55° by night, and 65° by day, or 70° by sun-heat. When a sufficient number of fruits are set, clip off the others that are forming in succession. At this stage of their growth, manure water may be safely given; previous to flowering, the supply of this should be limited, especially if the plants are disposed to grow to leaf rather than fruit.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Wheel manure and fresh soil, if necessary, on the beds, when frost renders the walks sufficiently hard for the operation. In favourable weather, trench vacant beds; dig or fork spaces between plants, leaving the surface rough.

Plant deciduous trees and shrubs if the ground be not too wet, and mulch the more tender when planted. Protect half-hardy plants. Make gravel walks. Lay turf and box-edgings. Turn old gravel walks, and immediately roll them well; then put over them a coating of fresh gravel. After wet weather, roll down the edges of grass adjoining gravel walks, so that, when fresh-edged, they may not be higher than 1 inch above the gravel.

Prune all deciduous plants and climbers, and those against walls should be trained and nailed. Cut hawthorn and other hedges of a deciduous nature; fork over the soil at their roots, taking care to remove all roots of weeds that would otherwise spring up.

Plant anemones, if not already done, and protect the beds. Plant also, at the first opportunity, any bulbs of narcissus that may not have been got in. Prepare ranunculus beds, by forking in well-decayed cow-dung and leaf-mould. If plants of pinks and carnations have been loosened by frost, they should be fastened by carefully pressing the soil, but this should not be done whilst the ground is very wet. Fasten down the shoots of heart's-ease, and

cover them nearly to their extremities with fine soil. Protect tulip-beds from heavy rains, but let them be uncovered in favourable weather; also protect lilies from frost, with leaves or old tan.

Plant roses in ground well trenched and manured. Prune such as are required to flower early. With regard to weak plants, early pruning will invigorate them, for pruning when the sap is in rapid flow tends to weaken the rose tribe; but it occasions a later development of the flower-buds, and is, therefore, to be practised when this object is in view. Protect tender sorts.

V.—PITS AND FRAMES.

There are various kinds of these very useful structures. Some are without fire-heat, and serve for protecting the less tender plants, including those called florists' flowers. This class is termed *cool pits* or *frames*. Having no artificial heat, it is necessary that good coverings should be prepared for them in case of severe frost. Others are heated so that half-hardy and green-house plants may be grown, and preserved even in severe weather. A third description should have a command of temperature for both top and bottom heat, so that plants of any kind may be forced or propagated in them; hence they are termed *forcing* or *propagating pits*.

Auriculas.—Protect from frost and rain; but, these being guarded against, give as much air as possible, in order to keep the plants hardy. Water sparingly. Remove decayed leaves. Sow in pans.

Calceolarias.—Shift, if necessary, and fumigate occasionally, so that the plants may be kept free from green fly.

Carnations and Picotees.—Unless the air is dry, with sun, no water will be necessary at this season. Give all the air possible, provided it is not frosty. Stir the surface of the soil in the pots, and remove all decayed portions of leaves.

Cinerarias.—Shift into larger pots some of those intended for early flowering. Introduce others for forcing.

Dahlias.—Remove decayed tubers from the sound ones; or, if only a portion of a root be decayed, let that be cut off, and the section dried; or the sound portions may be forthwith propagated, if a scarce sort.

Fuchsias.—Prune such as have been at rest;

reput in rich soil, and place in gentle heat for starting.

Hollyhocks.—Expose fully to the open air, when the weather is at all favourable. Cuttings from old stools may be propagated in small pots, and plunged in gentle heat for later flowering.

Polyanthuses should be kept in a cold frame, with moderate moisture and plenty of air.

Ranunculuses.—Sow seeds in pans. Plant in pots for early flowering.

Roses.—Introduce, to force, in a temperature of 60° to 65°, bottom heat; and 55° to 60° top heat.

Introduce, to force for flowers, giving gentle heat at first, azaleas, bulbs of various kinds, correas, franeiseas, gardenias, lilacs, lily of the valley, mignonette, pinks, Chinese primroses, rhododendrons. Start, into a growth of fresh shoots to be propagated, various bedding-out plants, such as verbenas, salvias, petunias.

VI.—GREEN-HOUSE.

In this month, green-house plants should not be stimulated by heat; and although many of them will bear a temperature nearly as low as the freezing-point for a short time, either here or in their native countries, without being apparently injured, yet such must be considered an exception to that which is natural to their constitutions; and, therefore, the temperature should not be allowed to fall below 40°, unless in very severe weather, when that point could only be maintained by so much fire-heat as would render the air of the house too parching. Amongst the plants usually introduced to this structure, some require a considerably higher temperature than others; and on this account it will be advisable to aim at a temperature of 40° to 45° at night, and 50° by day, or 55° with sun-heat and plenty of air. Air must be freely admitted; and if it should be too damp, although sufficiently mild, fire-heat should be given to raise the internal temperature two or three degrees throughout the day, above that of the external air. Water sparingly, but effectually, when the soil in the pots indicates the want of it.

In general, hard-wooded plants, such as heaths and epaerises, should be where they will have the freest circulation of air.

Soft-wooded plants should be placed as near the light as possible. Remove all leaves as soon as their certain decay is apparent. Keep the foliage clean, and fumigate, if the green fly appear. Keep up a succession of flowering plants from the pits and frames.

VII.—PLANT STOVE.

Tropical plants will not bear a low temperature, but they should be excited as little as possible at this dull season.

The temperature may be as low as 60° by night, and 65° by day, or 70° with sun-heat. Much air is not necessary. Water sparingly; plants at rest will scarcely require any. Prune or head-back such plants as require to be so treated; but before these are shifted, let them push into fresh growth. Sow seeds of stove plants towards the end of the month. Orchids commencing fresh growth may be repotted, or placed on fresh blocks or baskets. Those which are still dormant should be kept rather dry.

FEBRUARY.

County.	Place.	Latitude.	Longitude.	Mean temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	44.90	4.89	21
Middlesex...	Chiswick...	51 29	0 18 W.	38.71	1.54	30
Gloucester.	Stroud.....	51 45	2 13 W.	37.50	2.39	30
Lincoln....	Boston	52 48	0 5 W.	37.31	1.48	20
Dublin.....	Dublin.....	53 21	6 11 W.	40.72	...	17
Lancashire.	Liverpool...	53 25	2 59 W.	42.29	...	25
Dumfries...	Applegarth...	55 13	3 12 W.	35.92	2.35	19
Mid-Loth...	Edinburgh.	55 58	3 11 W.	39.00	2.00	20
Aberdeen..	Aberdeen...	57 9	2 5 W.	39.03	...	8
Orkney.....	Sandwich...	59 5	3 17 W.	38.44	4.23	26

I.—KITCHEN GARDEN DEPARTMENT.

Continue to manure, dig, or trench all vacant ground when the weather will permit, performing these operations, however, only in dry weather. Protect, if necessary, with litter, spruce branches, &c., such things as require protection. Examine stored roots.

Asparagus.—Dress beds of.

Balm.—Propagate by division.

Beans.—A sowing of Marshall's Dwarf may be made in the beginning of the month, and a fuller crop towards the end. Those which have been raised in heat may be hardened off in the open air, protecting them in case of frost.

Broccoli.—Sow some of the Waleheren.

Brussels Sprouts.—Sow for an early plantation, where the plants can be sheltered in case of severe weather.

Burnet.—Propagate by parting the roots.

Cabbages.—Sow some of the Early York in a warm situation for summer crops. A sowing may be made in the beginning of the month, and another at the end. Some of the autumn-sown plants may also be transplanted from the seed-beds.

Cabbage (Red).—Sow some in the end of the month.

Carrots.—Towards the end of the month, a few rows of the Early Horn may be sown in a warm situation.

Chervil.—Sow in the last fortnight.

Chives.—Plant roots in common soil about eight inches apart.

Dill may be sown in the end of the month.

Fennel.—Sow in shallow drills.

Garlic.—Plant in drills. Set the cloves two or three inches deep, and from six to nine inches apart.

Horehound.—Plant divisions of the root.

Horse Radish.—Plant in ground well trenched and manured.

Jerusalem Artichokes.—Plant in any spare part of the garden.

Leeks.—Sow some in the last week.

Lettuces.—Sow Paris Cos and Neapolitan Cabbage Lettuce. Plant out some of those sown in frames, if the weather be favourable.

Liquorice.—If the weather permit, plant cuttings of the roots.

Mint.—Propagate by offsets.

Mustard.—Make successional sowings in a warm situation every week, or as often as required.

Onions.—Sow in the last week. The Portugal may be sown on a good border, and afterwards transplanted; by so doing a great increase in size will be obtained.

Parsley.—Sow to succeed the autumn-sown.

Pease.—Sow the Early Frame and Early Charlton in the beginning of the month; and, as a dwarf, Bishop's New Long-pod. To these the Auvergne, sown in the middle of the month, will form a succession. Knight's Dwarf Marrow and Woodford's Green Marrow may be sown at the end of the month for further succession.

Potatoes.—Plant early kinds in a dry, warm situation.

Radishes.—Sow Long White, Long Scarlet, Semi-long Scarlet, Early White Turnip rooted, and Crimson Turnip-rooted, on a warm border. Cover with litter till the plants are above ground, and afterwards protect at night in severe weather.

Rhubarb.—Make fresh plantations by dividing the roots in pieces, with a bud to each. Plant these 3 feet from each other, in rows 4 feet apart.

Rocambole.—Propagate by planting the cloves of the bulbs.

Savoys.—Sow the Early Ulm, also some of the Large Green, about the middle of the month, for a first crop. Sown thus early they will be of larger size.

Shallots.—Plant the bulbs in newly trenched ground at the distance of 6 inches from each other, in shallow drills 1 foot apart.

Spinach.—Some of the Round-leaved may be sown between the rows of pease.

Tansy.—Propagate by dividing the roots.

Tarragon.—Divide the roots, and plant.

Turnips.—Some of the Early White Dutch may be sown in light warm soil.

II.—HARDY FRUIT DEPARTMENT.

All operations, such as trenching, manuring, and otherwise preparing the ground, recommended to be done last month, if not accomplished, owing to the state of the weather or other causes, should now be performed as early as possible.

Plant, where required, all sorts of fruit-trees; and, at the first opportunity, more especially the apricot, peach, nectarine, and quince, because they push early, and the more vegetation is advanced the greater will be the check from removal, and the less the growth of the trees in the ensuing season. Stake newly planted trees, or others the stems of which are not perpendicular.

Continue to prune all kinds of fruit-trees except the fig, walnut, and mulberry, which had better be left till danger of severe frost is past. Cuttings for grafting may yet be taken off.

Train and nail wall-trees; and in the first place those which are most forward, or which are on a southern aspect. Beware of over-tight shreds, and do not drive the nails so near the branches as to gall the latter when they increase in size.

Head back stocks, if not already done. Prepare clay for grafting, by mixing it with cow-dung and a little fine hay. If the weather be fine towards the end of the month, grafting may be commenced.

Prepare protection for the blossoms of wall-trees. Thin canvas is the best; but spruce branches or fern may be used, or thin straw screens may be worked in bad weather.

Clean the stems of fruit-trees from moss and scale, if any such exist, choosing a moist time for the operation. Use, in the first place, for the moss, a piece of hard-wood with triangular edges; then, with a hard scrubbing-brush, sand, and water, scour off all extraneous matters from the stem. Look out, in pruning, for the eggs of insects glued in rings on the young shoots; remove and effectually destroy them. Syringe peach trees after nailing, and before the blossom buds are too far advanced, with sulphur and water thoroughly mixed; with this, also, the whole surface of the wall should be well syringed.

Attend to strawberry plantations: thin old ones that are too thick, and make new ones if necessary.

III.—FORCING DEPARTMENT.

Asparagus.—Keep up a succession, as directed last month.

Basil.—Sow in pots for early use, and to rear for planting out. Pot off plants, if any previously sown are fit.

Capsicums.—Sow in pots, or on a moderate hot-bed; repot or transplant, but still in heat, when the plants have made four or five leaves.

Carrots.—Sow the Early Horn on a slight hot-bed.

Cauliflowers.—Sow a few in pots, or in frames, to be forwarded with a very gentle heat.

Celery.—Sow on a slight hot-bed, or in boxes or pans. Thin out the weakest.

Egg Plant.—Transplant or repot those sown last month.

Endive.—Sow, if required early, some of the Fine Curled Italian Summer Endive in a heat of 75°. Transplant when the plants have made four or five leaves, but in gentler heat, where they may become fit for use in May.

Kidney Beans.—Sow the Black Belgian, or any other early dwarf kind, in pots, for succession. Pinch the top shoots to make the

plants branch. In order to keep down the red spider, syringe frequently with water, a few degrees below the temperature of the house or pit, the air of which should be in a saturated state at the time; a deposition of moisture destructive to the insects will thus be made over the whole surface of the plants.

Lettuces.—Plant a succession on the beds from which the crop has been cleared off; much heat must not be given, between 55° and 60° will be sufficient. Sow on a slight hot-bed for a succession to those sown in autumn.

Mint.—Continue to force in succession as may be found necessary.

Mushrooms.—Means should be taken to bring the heat of beds, previously made, to about 60°, and they may then be spawned.

Mustard and Cress.—Sow successionally.

Onions.—Sow in very gentle heat for transplanting.

Pease.—Those raised in heat must now be merely protected from frost and cutting winds.

Potatoes.—Those forwarded in pots, as directed last month, may be planted out on a gentle hot-bed. Some may be transplanted into larger pots.

Radishes.—Sow in gentle heat.

Rhubarb.—Place roots in a forcing-house or pit, cover them with soil, and place a large flower-pot over them, if required to be somewhat blanched.

Sea Kale.—Take up roots, two or three years old, from the open ground, and plant in a pit kept completely dark; or pot such plants, and force them in a mushroom-house.

Tomatoes.—Sow in 3-inch pots.

Marjoram.—Sow in pans for planting out.

Sage.—Introduce plants in pots to gentle heat.

Cucumbers.—Prepare dung for succession beds. Such as are already formed, and in proper condition, should have hillocks of soil put in for the plants, so that the latter may be within 6 inches of the glass. Peat soil, if good, answers well, or rich light turfy loam and leaf-mould. Shift seedling plants into 3-inch pots when they show the third leaf; afterwards pinch the leading shoot which rises above this leaf. As other shoots break, allow three or four of them to proceed; when the most forward has made two joints, pinch off one; and when from the axil of the remaining leaf the bud is ready to push a fresh shoot, stop the next strongest shoot. Then

proceed at intervals till all the three or four, according to the sort of cucumber or size of the frame, are stopped.

Add about 2 inches of fresh soil as the roots of the plants approach the surface of the hillocks; but take care to lay it previously in the frame, to acquire the same temperature as that of the soil in which the plants are growing.

Maintain the proper temperature in the beds by turning and renewing the linings. Give as much air as will prevent the plants from making a greater expansion of foliage than the amount of light at this season can render substantial; but chilly draughts of air must, at the same time, be especially guarded against.

Melons.—Sow for succession, or for a first crop, if a very early one is not required. When the plants have made three or four leaves, they must be pinched back above the second leaf; and, in a day or two after, the cotyledons, or seed leaves, should be cut off. In consequence of the stopping two laterals will push, and when these have grown to about a foot in length, they must be pinched back above the third or fourth leaf. This will occasion laterals to push, and these must be pinched in the same manner as the primitive branches. Remove the first flowers. Maintain a heat of from 75° to 80° in the bed.

Pine Apples.—Prepare soil, and keep it in a sufficiently dry condition for potting. Tan and leaves should be at hand in sufficient quantity for a general shift at the end of this, or beginning of next month; but if any plants are not thriving, although well-conditioned as regards heat and moisture, let them be shifted immediately. The bottom heat may be a little higher than last month, but should not be allowed to get lower. Eighty degrees of bottom heat will be a good medium for fruiting plants.

Vines, of which the forcing is now to be commenced, may have a somewhat higher temperature than was recommended for those started last month. In other respects the previous directions will be applicable. With respect to the more advanced, stop and thin the shoots, and keep those regularly tied which it is necessary to retain. In removing shoots, proceed first with the removal of those at the upper part of the house, taking care, however, of the leaders; then gradually work downwards, so that the vines may not be injured

by the loss of too much foliage at one time. Continue to thin bunches where necessary, and the berries, likewise, whilst they are very young. Keep a moist atmosphere, except when the vines are in flower. In cold weather, when much fire-heat is necessary, it is difficult to maintain a proper degree of moisture in the air of the house, especially at night when it ought most to prevail, because the greater coldness of the glass acts as a condenser of the moisture existing in the internal air. This would be greatly remedied by keeping the glass comparatively warm by a covering of frigi-domo, or other suitable material.

Figs.—These, as they advance in growth, will require great attention in respect to a sufficient supply of water. Syringe frequently, and occasionally with sulphur in the water, in case of red spider. Pinch the terminal buds at five or six joints beyond the fruit. The temperature may now be from 55° to 60° at night, and 65° to 70° in the day.

Peaches and Nectarines.—Give continued attention to the removal of foreright, and other shoots not required for succession. Syringe frequently, and sprinkle the trees with tobacco-dust, or with snuff made from tobacco, in case of green fly. Dust the trees with sulphur, and more freely on the very first appearance of mildew. Increase the temperature several degrees as soon as the fruit is set.

Cherries.—Guard against too high a temperature at night, or even by sun-heat, till after the fruit is set. More water at the root than is just sufficient is very injurious, especially till the fruit is stoned.

Strawberries.—Introduce a succession as the plants that have borne their crop are removed.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Prune trees and shrubs, removing in the first place all dead, decaying, and unsightly branches; then thin and regulate where overcrowding and confusion exists. Estimate the growth which plants will probably make in the course of the season, and if this is likely to be too much for their respective spaces, a portion of the plants may be taken up for planting elsewhere if required, whilst some of those left can be shifted, so as to produce the best effect. A shrubbery should be sufficiently close, but not crowded. The ground may then be dug. Trench and prepare the ground for new shrubberies, which may be planted if the weather

prove favourable. Trench ground for lawns; these may be sown down towards the end of the month. Make new walks, and fresh-surface old ones. Keep their surface firm by rolling. Lay box and other edgings. Sweep lawns, to scatter worm-casts as a top-dressing, where these are numerous; and roll after the soil has been washed down among the roots of the grass. Prune and train climbers.

If the soil be in working condition, herbaceous plants, requiring fresh arranging, may be removed, divided, and replanted in newly prepared soil.

Plant out anemones and ranunculuses. Protect tulips.

V.—PITS AND FRAMES.

Auriculas.—Top-dress with rich soil. Young plants in small pots should be shifted into larger. An increased supply of water will be required as the plants start into active vegetation. Protect from frost, but give always plenty of air when the weather is favourable.

Azaleas must be kept from damp by a free circulation of air.

Calceolarias.—Shift and keep in a genial moist atmosphere.

Carnations.—Clear off all dead foliage; stir and refresh the surface of the soil.

Cinerarias.—Repot for late flowering into 6-inch pots.

Dahlias.—Start in moderate heat, in order to produce cuttings for striking next month.

Fuchsias.—Propagate by cuttings for general stock.

Heart's-ease.—Plant out if the weather is mild. Repot.

Hollyhocks.—Sow. Repot those sown in autumn. Propagate by shoots that will now be pushing from old stools.

Mignonette.—Sow in pots, in gentle heat, for early flowering.

Pelargoniums.—Shift generally; stop closely those for late flowering.

Ranunculuses.—Sow in pans, and place in a cool close frame.

Roses in pots will require frequent inspection, to detect the rose maggot and the green fly.

Stocks.—Sow Ten-weeks.

Propagate exotics by seeds, cuttings, &c.

VI.—GREEN-HOUSE.

The temperature of this must still be kept

so low as not to excite the plants to make shoots, which would be very imperfect, compared with those pushed later in the season, under the influence of increased light and other favourable circumstances. A night temperature of from 40° to 45° may, therefore, be considered generally sufficient; and the highest in the day should be from 50° to 55° . It may rise to 60° by sun-heat with beneficial effect, as regards drying up damp, abundance of air being admitted at the time. Air should be freely given, and a little even at night when fine. Heaths should be placed in the more cool and airy part of the house; pelargoniums in the warmer, as should likewise plants in flower, when first introduced, which have been forwarded with heat in pits or frames.

Plants starting into fresh growth, whether hard or soft wooded kinds, will require to be fresh potted. Shift, for the last time, pelargoniums intended for blooming in July.

VII.—PLANT STOVE.

The temperature of 60° at night, and 65° by day, or 70° with sun-heat, will be sufficient in the beginning of the month, for the plants then require no more heat than is necessary

to keep them in health with the least possible excitement. But as light, and the length of the day increase, a few degrees higher may be gradually allowed, especially by sun-heat. The latter may be economized by shutting up in the afternoon with a temperature considerably elevated from that source, and thus the necessary amount of heat will be maintained with less fire-heat; and when this can be done, so much the better it will be for the health of the plants. With the increase of heat, and as the plants begin to exhibit signs of active growth, more water will be required by many of them; but it must be carefully supplied, according to the varied wants of the respective subjects. Prune and regulate where necessary. This should be done whilst the plants are in a comparatively dormant state, and if so the sap will have time to stimulate buds to push before shifting or repotting has to be performed.

Ascertain what plants will require to be shifted, and proceed in the first place to shift those that exhibit the most active signs of starting into fresh growth. If any are found with bad roots they should be afforded additional bottom heat after shifting, if possible, in order to encourage the emission of young roots.

MARCH.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall ..	Penzance...	$50^{\circ} 7'$	$5^{\circ} 33' \text{W.}$	$45^{\circ} 32'$	3.83	21
Middlesex...	Chiswick...	$51^{\circ} 29'$	$0^{\circ} 18' \text{W.}$	$42^{\circ} 09'$	1.34	30
Gloucester.	Stroud	$51^{\circ} 45'$	$2^{\circ} 13' \text{W.}$	$40^{\circ} 65'$	2.50	30
Lincoln	Boston	$52^{\circ} 48'$	$0^{\circ} 5' \text{W.}$	$41^{\circ} 67'$	1.53	20
Dublin	Dublin	$53^{\circ} 21'$	$6^{\circ} 11' \text{W.}$	$43^{\circ} 24'$	...	17
Lancashire.	Liverpool..	$53^{\circ} 25'$	$2^{\circ} 59' \text{W.}$	$44^{\circ} 44'$	...	25
Dumfries...	Applegarth	$55^{\circ} 13'$	$3^{\circ} 12' \text{W.}$	$38^{\circ} 84'$	2.00	19
Mid-Loth..	Edinburgh.	$55^{\circ} 53'$	$3^{\circ} 11' \text{W.}$	$42^{\circ} 00'$	1.75	20
Aberdeen ..	Aberdeen ..	$57^{\circ} 9'$	$2^{\circ} 5' \text{W.}$	$42^{\circ} 80'$	...	8
Orkney...	Sandwich..	$59^{\circ} 5'$	$3^{\circ} 17' \text{W.}$	$40^{\circ} 46'$	2.30	26

I.—KITCHEN GARDEN DEPARTMENT.

If bad weather or other causes have rendered it impossible to act up to the directions given for last month, as regards various operations, these should now be proceeded with; and trenching and digging should be brought up, and the ground by the end of the month should either be cropped or ready for being so. It is scarcely necessary to observe that weeds should be destroyed wherever they are seen to exist; but, even where they do not,

the surface of the ground should be occasionally stirred amongst crops in order to destroy broods of slugs and other hurtful insects.

American Cress may be sown.

Angelica.—Transplant that sown in autumn; plant 2 feet apart in moist soil.

Artichokes.—Dress beds, clearing them of the litter or rotten leaves used for protection. If fresh plantations are required, plant suckers in well-dug ground, in rows from 3 to 4 feet apart, and at 2 feet distance in the row.

Asparagus.—Sow in drills 18 inches apart. Make new plantations. Dress beds.

Balm.—Part the roots and plant a foot apart.

Beans.—Those raised in heat should be transplanted to a warm situation as soon as the weather will permit. Sow full crops in the beginning and end of the month. Earth up those above ground.

Beet.—A little may be sown for autumn

use; also some of the White or Silver Leaf-beet.

Borage.—Sow broadcast, or in drills, in a dry situation.

Borecole.—Sow the principal crop for autumn and winter supply.

Broccoli.—Sow Walcheren, and other sorts, towards the end of the month. Some should be sown in a cold frame; more especially if, owing to frost or wet, the soil elsewhere is in bad condition for the seeds.

Brussels Sprouts.—Sow a little in the first week, to come in early; and towards the end of the month for the main crop.

Burnet.—Sow in drills.

Cabbages.—Sow, about the middle of the month, the Early York, Early Battersea, Vanack, or Fulham, for summer and autumn supply. Plant out a full crop of those sown in autumn.

Cabbages (Red).—Plant out those sown in autumn in the beginning of the month; and about the same time another sowing should be made for a later supply.

Caraway.—Sow.

Cardoons.—Sow a few in the last fortnight for an early crop.

Carrots.—Sow some of the Early Horn in the beginning of the month, if the weather is favourable. The main crop of this and other sorts should be sown about the middle of the month, or as soon after as the weather and state of the ground will permit.

Califlowers.—Sow in the last fortnight for a late summer crop. Plant out a few from under hand-glasses.

Celeriac.—Sow on a warm border.

Chamomile.—Divide the roots, and plant them 8 inches apart.

Chervil.—Sow broadcast, or in shallow drills 6 to 8 inches apart.

Chives.—Plant offsets, or divisions of the patches of the roots, 9 inches apart.

Coriander.—Sow, if not done in autumn.

Corn Salad.—Sow broadcast, or in drills 8 inches apart.

Cress.—Sow weekly, in a warm situation.

Dill.—Sow broadcast, or in shallow drills a foot apart.

Fennel.—Sow in drills 18 inches apart.

Garlic.—Plant the cloves 6 inches apart, in shallow drills a foot from each other.

Horse Radish.—Plant pieces of the roots, or the crowns, a foot apart, in the bottom of trenches 15 inches deep; or make holes in

well-trenched ground to that depth, and drop in the pieces.

Hyssop.—Renew, by dividing and planting in fresh soil.

Jerusalem Artichokes.—Plant in rows 3 feet apart, and 1 foot in the row.

Leeks.—Sow early in the month for transplanting.

Lettuce.—Plant out on borders from frames. Sow both Cabbage and Cos lettuces in the beginning of the month on a south border.

Liquorice.—Plant cuttings of the roots 18 inches apart.

Marjoram (Pot).—Divide the roots, and plant in warm soil.

Marygold.—Sow about the end of the month.

Mint.—Divide the roots, and plant new beds.

Mustard.—Sow every week in a warm situation.

Nasturtiums.—Sow towards the end of the month.

Onions.—Sow the main crop, as early in the month as the ground and the state of the weather will permit, in shallow drills 6 inches apart. Transplant some of those sown in autumn.

Orach.—Sow.

Parsley.—Sow Hamburg, and other kinds, if not already done. The curled sort makes a neat edging.

Parsnips.—Sow the main crop in drills 1½ inch deep and 1 foot apart. The Hollow-crowned is considered the best.

Pease.—Sow main crops, including a good breadth of Knight's Tall Marrow. The latter should have not less than 6 feet between the rows, and the ground should be well trenched and manured for it.

Pennyroyal.—Divide the roots, and plant towards the end of the month, in a moist border.

Potatoes.—Plant main crops.

Radishes.—Sow for succession.

Rhubarb.—Make fresh plantations. Sow for a supply of young plants.

Rocambole.—Plant the cloves.

Rue.—Propagate by slips.

Sage.—Plant slips.

Salsafy.—A little may be sown in drills 8 or 10 inches asunder, but not the main crop.

Savory (Winter).—Propagate by dividing the roots.

Savoys.—Sow in the middle of the month for autumn use. For a very early supply, the Early Ulm may be sown in the beginning of the month.

Scorzonera.—Sow a few rows for autumn use.

Sea Kale.—Remove pots as the crop is taken, and place them over other plants to blanch a succession. Sow for a supply of young plants, to rear for forcing or for new plantations. Take up those sown in the previous March, and plant in rows 4 feet apart, and 18 inches from plant to plant in the row.

Shallots.—Plant early in the month, if not already done.

Skirret.—Sow in drills on rich, light, and rather sandy soil.

Spinach.—Sow Round-leaved; this may be done between the widest rows of pease.

Tansy.—Propagate by dividing the roots.

Tarragon.—Propagate by dividing. A fresh plantation should be made every spring, as the plants are apt to die off.

Turnips.—Sow Early White Dutch, or other early variety, in the last fortnight.

II.—HARDY FRUIT DEPARTMENT.

Finish pruning, in the first place, those kinds of fruit-trees in which vegetation is most forward, if any such are still unpruned. In this respect the apricot, peach, nectarine, cherry, and plum should receive the earliest attention; and the pruning of all other kinds, with the exception of the fig, should be completed as soon as possible.

Planting should also be finished without delay; and, after planting, a mulching of some kind will prove very beneficial, more especially to those trees planted at this season, when drying winds usually prevail.

Train and nail trees. Graft the cherry, plum, pear, apple, chestnut, quince, and medlar.

Protect wall-trees by nets, thin canvas, straw screens, spruce branches, fern, or by other means that may be at command.

Plantations of strawberries may be made, but as early in the month as the state of the ground will permit.

III.—FORCING DEPARTMENT.

Asparagus.—Keep up a succession in pits. A little heat, from fermenting materials put in the trenches, will now readily cause shoots to push for a supply from beds in the open ground.

Capsicums.—Sow, if not done last month. Pot off the plants when fit, and replace in heat.

Cauliflowers.—Expose freely; protect only from frost and hail. Weak plants, that are not progressing kindly, should be removed from amongst the more thriving. Transplant the latter as they become fit, under hand-glasses. Sow for a succession.

Celery.—Sow in pans, in rather brisk heat; but as soon as the seeds have germinated remove to gentle heat. Prick out those previously sown.

Egg Plant.—Shift as soon as the plants require larger pots.

Kidney Beans.—Continue to force in succession. The plants will require a liberal supply of water at the root, and by the syringe on the foliage; but if chilled by cold water they will become unhealthy in consequence, and a still more favourite prey of the red spider.

Lettuce.—Those in frames should be exposed day and night, unless the weather is severe. Plant out at intervals. Sow for succession.

Mushrooms.—Maintain a temperature of about 60° in the beds, and the same in the air of the house, which should also be kept humid.

Mustard and Cress.—Keep up successions.

New Zealand Spinach.—Sow in brisk heat.

Onions.—Those raised in boxes, for transplanting, should be gradually exposed to the air to harden them off.

Pease.—Those forwarded in pots should now be all planted out.

Potatoes.—Sulphur should be frequently distributed in the frames where these are growing, by means of some convenient kind of sulphurator. A little may also be mixed with the water supplied to the plants. The soil where the roots extend should not be allowed to get too dry; but that employed for earthing up, and in which the tubers are formed, should be dry and light.

Give plenty of air when the weather is favourable. Plant, for succession, those forwarded in pots or otherwise.

Rhubarb.—Fresh roots may be introduced into the mushroom-house, or any other place having a suitable temperature.

Sea Kale.—Keep up a succession.

Tomatoes may yet be sown. Pot off and shift.

Cucumbers.—Let the bottom heat be kept up to about 80°, and the temperature of the

air in the pit or frame to between 75° and 80°, or with sun-heat 85°. In dull weather, when the absence of sun-light occasions paleness in the foliage, and great weakness of shoots, a temperature 4° or 5° lower is advisable. By much heat, with but little light, long shoots and broad foliage will be produced; but the greater the heat, with insufficient light, the more lax will be the tissue of shoots and foliage. It is, therefore, better to grow the plants more slowly in dull than in bright weather.

Give air as the heat of the day increases, and reduce as it declines. The sashes may even be closed in the afternoon with a rather high temperature from sun-heat; but when they are covered for the night a little air should then be allowed. Water with tepid water of a temperature between 75° and 80°. Apply manure water when the plants are commencing to bear. Thin superabundant shoots before they produce confusion, and so frequently as to have but few to remove at any one time.

Melons.—Sow for the general crop.

The temperature of 80° bottom heat, and 75° as the average temperature of the air of the frame, should be kept up. The latter may be as low as 70° at night, and it may rise to 85° by sun-heat. Give air as directed for cucumbers.

Keep up a gentle moisture in the frames, but do not water close to the stems.

Pick off the flowers as they appear until the plants have acquired strength to support the young fruit; then some female flowers must be fertilized with a male flower, previously to which operation the air of the frame should be rather dry.

Pine Apples.—Those who adopt the Meudon plan of growing pines should now prepare a bed, half stable dung and half leaves. Upon this lay 10 inches deep of peat soil; turn the rooted suckers out of their pots, and plant in the peat soil, there to remain for the summer.

From amongst those a year older, and showing fruit, some of the strongest should be selected for being planted out of the pots into the bed of the fruiting-house. Those not turned out of the pots should be plunged in a prepared bed of dung and leaves, affording a bottom heat of 84°. The plants should be shaded, and little air given till they have taken fresh root, which will soon be the case with an atmospheric temperature of from 80° to 84°.

The pines cultivated according to the or-

dinary modes are generally shifted in this month.

Vines.—Attend to the succession-house as before directed. Tie in shoots before they get into confusion; there should be no crowding of branches, shoots, or foliage.

Thin the berries, taking care not to prick those intended to remain. If the points of the bunches are taken off, the berries will swell better. Tie up the shoulders of bunches and remove tendrils. Keep the air of the houses moist at night. Syringe frequently, but not directly upwards against the berries, for that spoils the bloom; but water coming in a downward direction does not.

Figs.—If any suckers make their appearance let them be immediately removed, otherwise the sap will flow into them in preference to the fruit-bearing portion, the young fruit on which would consequently drop. The same will be likely to occur, if, in any part, over vigorous shoots start up; therefore, such must be kept in check by pinching. Take care that the roots are regularly supplied with water. Keep the foliage clean by syringing and sprinkling with sulphur.

Peaches and Nectarines.—Continue to regulate the shoots, removing all that are superfluous. If any, trained in for bearing, have failed to produce, and are not required to prolong the branch, let them be cut back to the lower young shoot, if there is one at the base; and if there is not, cut at about $\frac{1}{2}$ inch from the base of the shoot. From this portion a young shoot, to be trained for succession, will likely spring. Thin the fruit partially at an early stage of its growth, leaving one to about a square foot, as soon as it can be ascertained which fruits are taking the lead in swelling, these, of course, being left in preference. Syringe morning and afternoon, and shut up early, but always allowing a little air at night.

Cherries.—When the fruit is set, the temperature may be increased to 55° at night and 65° in the day, or as high as 75° by sun-heat; but plenty of air must then be admitted. When the fruit is colouring, gradually increase to 60° at night and 70° in the day, or 80° by sun-heat. Great care is necessary to insure just sufficient moisture to the roots. Syringe the foliage, and fumigate in case of the least appearance of aphides.

Strawberries.—Introduce a succession, and attend to former directions.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Finish the pruning of trees and shrubs. Clip holly hedges. The planting of deciduous trees and shrubs should be completed as early as possible; and if the weather be moist in the end of the month, evergreens may then be planted. Ground that has been rough-dug should be hoed and raked when moderately dry; but the borders of the shrubbery next the walk, where flowers are to be planted out, or where annuals are to be sown, should be nicely worked and pointed over with the spade. In short, when the ground is in good working condition, the earliest opportunity should be taken to dress beds and borders for the reception of the respective plants intended to be put into them.

Many hardy annuals, biennials, and perennials may be sown in the beginning of the month, provided the ground is dry; but otherwise, the sowing had better be deferred till a later period, for some kinds are apt to perish in cold wet soil.

Half hardy annuals may be sown in the end of the month.

Plant carnations, heart's-ease, hollyhocks, dahlias, gladiolus, and ranunculus roots, if not before done.

V.—PITS AND FRAMES.

Auriculas.—Protect from frost and cutting winds; but let them be freely exposed when the weather is fine.

Calceolarias.—Remove all decaying foliage, and keep the plants free from insects. Shift any that require it.

Carnations.—Shift into 8-inch pots, two plants in each, taking care that they are previously clear of insects. After potting, shelter from bad weather.

Cinerarias.—To prevent mildew, apply flowers of sulphur; and fumigate if green fly make its appearance.

Dahlias.—Sow; also propagate by cuttings.

Hollyhocks.—Plant out seedlings as soon as the weather permits.

Pelargoniums.—Keep the foliage clean by syringing, and expose it as much as possible to light. The temperature at night should not fall below 45°; an abundance of air should be given during the day.

VI.—GREEN-HOUSE.

In clear weather, the sun's rays in this

month become powerful, and a corresponding amount of ventilation is therefore necessary; but at this season, the nights immediately succeeding the brightest days are often frosty, so that there are two extremes to be guarded against. It will be necessary to give abundant ventilation, and in some cases shading, when the sun-heat would otherwise raise the temperature of the internal air too high; and when frost is apprehended, the house should be shut up rather early, and closely, so as to render little fire-heat necessary. The air is generally very dry in this month, and, when such is the case, means must be taken to maintain sufficient moisture in the air of the house. The paths, and the surface of the soil in the pots, must be kept moist, and the plants should be frequently syringed. They will also require more water for their roots than in the previous months; and some kinds of soft-wooded plants, requiring to be invigorated for producing large flowers, should be occasionally supplied with clear manure water.

Continue to shift plants, in order that they may make fresh roots before they are placed out of doors for the summer. Top-dress those that may not require shifting, but see that none are pot-bound. Prune, to produce handsomely formed specimens. Branches occupying similar positions on the same plant should possess equal vigour. If this is not the case, the weaker must be encouraged by repressing the stronger. In some cases the latter may be bent down, in others it will be necessary to use the knife. Remove as far as possible all shoots that are affected by damp, or that are otherwise unhealthy.

VII.—PLANT STOVE.

With an increased amount of light in this month, the temperature should be increased. The house should be shut up, or at all events the air greatly reduced, early in the afternoon, whilst the temperature is between 85° and 90°; and it may be allowed to fall not lower than between 65° and 70° at night. Shift orchids, and other plants, as they commence to make fresh growth. After being shifted the plants require to be kept more close and warm than usual, till they make fresh roots, and till then water should be sparingly given; they should also be shaded

from the rays of the sun. Take care that no plants are grown quicker than is consistent with the amount of light necessary to produce a sound tissue, and a foliage of the healthiest

natural hue. Endeavour to maintain a moist atmosphere at night; but let the foliage be dry for an hour or two every day, by means of air gradually admitted.

APRIL.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in Inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	48·07	3·35	21
Middlesex...	Chiswick...	51 29	0 18 W.	47·13	1·55	30
Gloucester.	Stroud	51 45	2 13 W.	45·60	2·75	30
Lincoln.....	Boston	52 48	0 5 W.	47·52	1·53	20
Dublin	Dublin	53 21	6 11 W.	48·05	...	17
Lancashire.	Liverpool..	53 25	2 59 W.	48·06	...	25
Dumfries.	Applegarth	55 13	3 12 W.	43·27	1·85	19
Mid.-Loth.	Edinburgh	55 58	3 11 W.	46·00	1·80	20
Aberdeen..	Aberdeen ..	57 9	2 5 W.	47·57	...	8
Orkney.....	Sandwick..	59 5	3 17 W.	43·44	1·73	26

I.—KITCHEN GARDEN DEPARTMENT.

The weather in this month is generally showery; but sometimes dry easterly winds prevail with cold nights. Under these circumstances the watering of crops should be done in the mornings, and then only when absolutely necessary. Stir the surface of the ground among crops whenever it can be done. Weed beds, and hoe and rake the alleys, so that the whole may exhibit a neat appearance.

American Cress.—Sow in drills 9 inches apart.

Artichokes.—Dress beds, and make fresh plantations, if not already done.

Asparagus.—Dress beds; after forking, rake the surface fine and gather off stones. Sow not later than the first or second week. Plant, if prevented from doing so last month by bad weather.

Balm.—Divide the roots.

Basil.—Sow. This plant, however, is generally better raised on a slight hot-bed.

Beans.—Sow successions; draw earth to those already up.

Beet.—Sow the main crop, from the middle to the end of the month. In dry weather the seed should be steeped a day before sowing.

Borage.—Sow a little for a succession.

Borecole.—Sow in the first fortnight.

Broccoli.—Sow the Walcheren and early varieties. In cold situations the late sorts may also be sown about the middle of the month; but in warm spots it will be better deferred till next month. Protect the heads which have formed, by turning one or two leaves over them.

Burnet.—Sow, or divide the roots and plant.

Cabbages.—Sow, in the first week, the Early Battersea, Vanack, or Fulham, for autumn use. Sow the Utrecht Small Dark Red in the second week.

Caraway.—Sow, if not done in autumn. Thin the plants to 8 inches apart.

Cardoons.—Sow, about the middle of the month, in patches of three seeds, 18 inches from patch to patch, in well-manured trenches 4 feet apart.

Carrots.—Sow in succession, and hoe between the rows of early sown crops.

Cauliflowers.—Sow in the first fortnight. As the plants from former sowings become fit, they should be planted out; if the weather should afterwards prove unfavourable, protect by inverting flower-pots over the plants at night.

Celeriac.—Sow on a warm border of rich soil.

Celery.—Sow in the beginning for late crops. Prick out, and give plenty of water.

Chamomile may be propagated by dividing the roots.

Chervil.—Sow in shallow drills.

Chicory.—Sow thinly, in rows 8 inches apart, for plants to blanch in winter.

Clary.—Sow, if not done last month.

Cress.—Keep up a succession, by sowing weekly in a warm situation.

Dill may be sown.

Endive.—Sow a small quantity of the fine curled Italian, to come in early.

Fennel.—Sow, or plant slips, if not done last month.

Garlic.—Stir the soil between the rows.

Hyssop.—Sow; or it may be propagated by rooted slips, or even cuttings.

Kidney Beans.—In the beginning of the month, sow a few in a warm soil and situation; also some in pots under protection, in case of the former failing. A fuller crop, for a succession, should be sown about the end of the month.

Kohl Rabi.—A little of the Early White

Vienna may be sown at the end of the month, for use when young, instead of turnips, if these should fail in very hot dry weather.

Lavender.—Sow, or propagate by cuttings and slips.

Leeks.—If the main crop was not sown last month, it should now be done. A late crop may also be sown in the end of the month.

Lettuce.—Sow successions, especially of White Paris Cos and Neapolitan Cabbage lettuce. Plant out from frames. Tie up the plants which are of sufficient size.

Marjoram.—Sow, in the beginning of the month, on a warm border.

Marygold.—Sow.

Mint.—Propagate by division.

Mustard.—Keep up a succession, by sowing weekly

Nasturtiums.—Sow in rows, in a compartment, or a single row in front of a paling. The latter mode is preferable.

Onions.—If the main crop was not sown last month, the sooner it is done the better. Hoe and thin the autumn-sown ones.

Oxalis Deppei.—Plant in rich light soil, in rows from 6 to 8 inches apart, and about an inch deep. Leaf mould is a good manure for this plant.

Parsley.—Hamburgh parsley, which is cultivated for its roots, should be sown in the beginning of the month. The French Large-rooted variety is the best. The Dwarf Curled, which is the best variety for garnishing, may also be sown.

Parsnips.—Sow early in the month.

Pease.—Sow in rows, 4 feet apart, Woodford's Green Marrow, Knight's Dwarf Marrow, Blue Prussian, Fairbeard's Champion of England, or other similar varieties; but a good sowing of Knight's Tall Marrow, in well-manured ground, should not be omitted, and the rows should be 6 feet apart for this sort.

Pennyroyal.—Plant slips.

Potatoes.—Draw earth to the plants as they appear above ground.

Purslane.—Sow broadcast on a warm border.

Radishes.—Sow successions once a fortnight, or more frequently if necessary.

Rhubarb.—Sow seed in light rich soil. Remove the flower stems when seed is not to be saved.

Rocambole.—Plant, if not before done.

Rosemary.—Sow, or propagate by rooted slips.

Rue.—Sow seeds, or propagate by cuttings.

Sage.—Propagate by slips.

Salsafy.—Sow, in the end of the month, in rows 1 foot apart.

Samphire.—Sow seeds, or divide the roots.

Savory (Summer).—Sow early in the month, on a warm border. Winter Savory may also then be sown, or it may be propagated by dividing the plant.

Scorzonera.—Sow the principal crop in the end of the month.

Scurvy Grass.—Sow on a cool border.

Sea Kale.—In the beginning of the month sow seeds, or propagate by cuttings of the roots, if new plantations are required.

Shallots.—Hoe and loosen the soil about the plants.

Skirret.—Sow on rich light soil, and afterwards thin to 6 inches apart.

Sorrel.—Sow or propagate by dividing the roots.

Spinach.—Sow successions of the Round-leaved.

Tansy.—Divide the roots, if a new plantation be required.

Tarragon.—Propagate by rooted slips; avoid planting in heavy, damp soil.

Thyme.—Sow in light soil, or propagate by dividing the plant.

Turnips.—Sow successions. Hoe and thin crops already up.

II.—HARDY FRUIT DEPARTMENT.

It is presumed that the planting and pruning of fruit-trees, as formerly recommended, is now finished, unless delayed in consequence of bad weather, or other unavoidable causes. The fig may be pruned in the beginning of the month. Apples and pear trees may yet be grafted. Apricots should be thinned. Continue to protect peaches and nectarines; but see that the coverings are not producing, by their warmth, tender foliage, that would afterwards suffer from exposure. If such is likely to take place, the protecting materials must be reduced. Disbud when any of the shoots have pushed so far as to require removal; but let this be done sparingly at first, and always gradually. If cold weather check, in a great measure, the flow of the sap, desist from checking it still more by disbudding, till the circulation again becomes more active.

Attend to newly grafted trees, and replace the clay if it has dropped off. In case of parch-

ing winds, some grafts may require to have moss tied over the elay, and to be kept moist.

See that apricots and other wall-trees, are not too dry at the roots. Weed strawberry plantations, and water them plentifully, in order to wash down the nutritive principles of the mulching to the extremities of the roots.

III.—FORCING DEPARTMENT.

Capsicums.—Shift into larger pots; place near the light in some forcing-house.

Carrots.—Expose freely in fine weather. Water, so that the extremity of the root may find sufficient moisture. Keep the foliage clean by syringing.

Cauliflowers.—Moisten well the soil in the frames two days before planting out.

Celery.—Prick out, 4 inches apart, on a layer of rotten dung mixed with old eucumber mould, or melon loam, laid about 4 inches thick on hard ground. Attend well to the watering of the plants, and shelter if the weather be unfavourable.

Egg Plant.—Train with one stem, pinch it in order that it may form two branches, which should afterwards be likewise pinched to form others. Keep the plants near the light, and give an increased quantity of air as the season advances. Syringe frequently. These plants soon evaporate the water supplied to the roots.

Endive.—Sow in a heat of from 75° to 80°, for if germinated slowly the plants are apt to run quickly to flower. Harden off gradually before planting out.

Gourds.—Sow in heat in the beginning of the month.

Kidney Beans.—Sow for succession.

Lettuce.—Expose freely, day and night, in favourable weather.

Mushrooms.—Collect horse-droppings, and keep them in a thin layer, in a dry place, till wanted for new beds. Maintain a moist atmosphere in the mushroom-house, with a temperature of between 60° and 65°.

Onions.—Transplant, after previous free exposure, those raised in heat.

Potatoes.—Those requiring to be earthed up should be effectually watered, and after this, when the surface is dry, the earth should be added.

Radishes.—Those forwarded in frames should now be freely exposed.

Cucumbers.—Maintain the heat previously

recommended. If cold north or east winds prevail, take great care not to admit an unbroken current of air. This object may be attained by drawing screens of gauze over the openings, which will require to be limited according to the briskness and coldness of the wind. Water or syringe the foliage with a fine rose before shutting up, which should be early in the afternoon. It is easy to see if the surface of the soil is always moist enough; but it is highly necessary to ascertain its condition as far down as the roots extend, and, if too dry, use water within a degree or so of the temperature of the soil, or about 80°. With water of this temperature the bed may be thoroughly soaked, except near the stems of the plants. Train, stop, and regulate the shoots frequently. Sow for ridging out.

Melons.—Attend to giving air and water as directed for cucumbers. Train so that no more shoots are allowed to grow than can have the foliage they produce fully exposed to light. Fertilize the female blossoms when the plants are strong enough to bring forward the fruit. Sow for a succession.

Pine Apples.—Newly shifted plants should have but little water at the roots till fresh ones begin to be emitted; when this is the case, and as the season advances, more air and water will be required. Plants ripening off their fruit should have a dry atmosphere, with a temperature of 84° and by sun-heat 95°.

Vines.—Attend to stopping and regulating the shoots, as before directed. Maintain a gradually increasing temperature as the berries increase in size. The vine will bear a much wider range of daily temperature than tropical plants will; but at the same time the average temperature to which it is subjected must progress. If it remain uniform for several weeks, the fruit will not attain the highest perfection; and if the temperature should be, on the average, uniformly lower than it ought to be for a week or two, and lower than it had previously been, the berries will be apt to shrivel, and will never become sugary.

Figs.—As the fruit swells increase the heat, and of course the moisture; but the latter must be limited when the fruit is ripening.

Peaches and Nectarines.—Tie in the shoots as they advance in growth, and in the first place those which would otherwise become too luxuriant. They may be laid closely to the naked parts of branches, but those springing nearest the bases of the bearing shoots, or

elsewhere, and eligible for succession shoots, ought not to be crowded. Keep the foliage clean, by frequent syringing, and the border should be duly watered. Give air in the morning, and reduce it when the temperature from sun-heat begins to decline.

Cherries.—As the fruit begins to colour, the temperature may be allowed to rise as high as 85° by sun-heat, and at night it may range from 55° to 60°. The fruit should be ripened off in a dry atmosphere.

Strawberries.—Clear manure water may be given alternately with pure water, unless the plants are inclined to grow too much to leaf. Clip off the upper part of the scape, as before directed, when a sufficient number of fruit is set below.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

As evergreens may now be planted, alterations and new works should be completed as early as possible. The borders and beds can then be kept neatly hoed and raked, the grass well rolled and mown; the walks should be kept free from weeds, and rendered firm and smooth by rolling. Spring flowers should be in sufficient abundance to give a varied colouring, and so that, either near or at distant points of view, flowers may be seen even at this early season.

Examine the stock of bedding-out plants, in order to ascertain the quantity of each kind available for planting out. This being done, the plan can be laid for completely furnishing the respective beds and borders throughout the season.

Plant perennials and bedding-out plants, according to the state of the weather; in short, all kinds of herbaceous plants that are not too tender, or too far advanced in growth.

Sow annual, biennial, and perennial flower seeds. Some of the former may be sown in the beginning, and the same sorts again in the end of the month, for a succession.

Prune evergreens; remove suckers from rose trees. Water all newly planted trees when necessary.

V.—PITS AND FRAMES.

Harden off bedding-out plants by free exposure to air and light. If the weather is mild, numbers of these may be planted out, and others may be placed in a warm, sheltered

situation, in order that the frames may be occupied with other plants.

Auriculas.—These will now require plenty of water, but not on the foliage. Shade from too strong sun when in flower.

Balsams.—Shift into very rich compost, and always before the roots get crowded.

Calceolarias.—Shift finally, and continue to fumigate if necessary, taking care, in so doing, not to injure the foliage.

Carnations.—Sow in gentle heat. Shift finally, and plant out in the borders or beds.

Cinerarias.—Water abundantly, and shade those in bloom from strong sun.

Dahlias.—Pot off cuttings that have rooted, keep them growing in gentle heat, but harden off preparatory to planting out next month. Continue to propagate by cuttings; seeds may also be sown.

Fuchsias.—These should be finally repotted. Attend to training, and syringe the foliage.

Heart's-ease.—Sow seed in a cold frame, and plant out seedlings.

Hollyhocks.—Plant out some for early blooming, and pot off seedlings.

Pelargoniums.—Those not in bloom may be slightly syringed three or four times a-week, before shutting up. Fumigate, in case of green fly. Give air on all favourable opportunities, and attend to training and regulating the plants. Harden off those intended for bedding-out.

Petunias.—Harden off previous to planting out.

VI.—GREEN-HOUSE.

The sun will generally afford sufficient heat for the plants in this structure, and sometimes even shading will be necessary. Abundance of air must be given, and, in proportion to its heat and dryness, an increased supply of water will be necessary. But this must not be given indiscriminately, for plants that are making but little growth will require a much less supply than those that are vigorous. Syringe the plants over-head several times a-week. Thin out shoots, and stop those which would otherwise not branch so as to form compact heads. Early flowering shrubby plants may be more or less pruned soon after the flowering is over. Repot those that are growing rapidly before their roots are too crowded, unless in cases where a moderate check is intended, in order to dispose the plants to flower,

The propagation of most kinds of green-house plants may now be effected.

VII.—PLANT STOVE.

The external rise of temperature of this month being considerable, less fire-heat will be required to maintain a higher temperature than was advisable in the previous one; at

the same time more air may be admitted. Water and syringe more freely. Shading, particularly for orchids, will be absolutely necessary, but it should be removed as early as possible in the afternoon. The house may be shut up, or nearly so, with a temperature from sun-heat of 85°. Continue to shift, propagate, and train, as circumstances require. Pot off seedling plants.

MAY.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	54° 54'	2.47	21
Middlesex...	Chiswick...	51 29	0 18 W.	53° 55'	1.85	30
Gloucester.	Stroud	51 45	2 13 W.	51° 00'	2.27	30
Lincoln....	Boston	52 48	0 5 W.	55° 52'	1.70	20
Dublin	Dublin.....	53 21	6 11 W.	54° 37'	...	17
Lancashire.	Liverpool..	53 25	2 59 W.	55° 27'	...	25
Dumfries ..	Applegarth.	55 13	3 12 W.	49° 24'	1.85	19
Mid-Loth..	Edinburgh.	55 58	3 11 W.	52° 50'	2.60	20
Aberdeen ..	Aberdeen...	57 9	2 5 W.	54° 29'	...	S
Orkney....	Sandwick ..	59 5	3 17 W.	47° 88'	1.72	26

I.—KITCHEN GARDEN DEPARTMENT.

Examine all seed-beds, in order to detect failures, and, if there are any, sow again immediately. The hoe should now be employed among rising crops. Weeding should be attended to wherever there is the least occasion, and thinning should take place before the plants encroach upon each other, either in the seed-beds, or in the permanently sown crops in the borders and quarters. Water only when absolutely necessary; but when watering is performed it should be done effectually. When the nights are cold, and the days hot and dry, this operation should be commenced as soon in the afternoon as the sun-heat is on the decline. After such plentiful watering let the surface of the ground become dry, then hoe and pulverize it, and, if this state be maintained, watering will not require to be so soon repeated.

American Cress.—Sow.

Angelica.—Cut down the stems; for, if allowed to run to seed, the plant will die off soon after.

Asparagus.—The shoots should be regularly cut as they become fit; none should be left to grow up until the season when cutting should be entirely discontinued. Take care not to injure the crown of the plants, nor shoots below the surface, with the knife.

Basil.—Plant out in rich warm soil.

Beans.—Sow successions; earth up and top crops sufficiently advanced.

Beet.—Sow Red Castelnauary in the beginning of the month. Thin early sown crops.

Borage.—Sow a little for a succession.

Borecole.—Sow in the beginning of the month, and again towards the end.

Broccoli.—Sow the principal crops; and some of the Walcheren, for succession, should not be omitted.

Brussels Sprouts.—Plant out some for early use.

Cabbages.—Plant out for principal summer crops as soon as the plants in the seed-beds are fit, taking advantage of cloudy weather, if such occur. It is better to plant when the weather is likely to change from dry to wet, than in the end of a wet period.

Capsicums.—Some may be planted out in a warm situation, protecting them at night.

Cardoons.—Sow in the beginning, and some at the end of the month; the latter for a last crop.

Carrots.—Sow some in the first fortnight, for drawing young. Thin as soon as the strongest plants can be distinguished. Weed and hoe between the rows of those already up.

Cauliflowers.—Those forwarded under glass should be planted out when the ground is moist. The crop for autumn use should be sown before the 24th. Water the plants copiously when they require it, and protect formed heads from the sun by breaking leaves over them, otherwise the curd will not be pure white.

Celery.—Prepare trenches, for an early crop, 3½ or 4 feet apart, 1 spit deep, and 18 inches wide, laying the earth with a good slope, in order to catch the rain. Abundance of manure, consisting of a mixture of cow-dung and rotten stable-dung, should be dug in the bot-

tom of the trenches. Carefully remove all suckers from the plants; then plant them about 9 inches apart, and water immediately.

Chervil.—Sow.

Cress.—Make successional sowings.

Cucumbers.—Prepare ridges for gherkins, for pickling. The seeds may be sown on the ridges under hand-glasses; or plants, reared in pots for the purpose, may be planted out, if the weather be sufficiently mild. They should be protected at night.

Egg Plants.—Towards the end of the month some of these may be planted out on a rich warm border, at the foot of a south wall.

Endive.—A small sowing of the Green Curled, for early use, may be made in the end of the month.

Gourds.—Plant out into the open ground, in the end of the month, protecting at night; or sow in the last week, in a warm situation.

Kidney Beans.—Plant out from under glass. Sow successions, in rows 18 inches apart.

Leeks.—Sow for a late crop, and transplant the earlier sown ones.

Lettuce.—Sow successions of the White Paris Cos, also Malta, and Neapolitan Cabbage lettuces; transplant from seed-beds; tie up for blanching such plants as require this to be done.

Marjoram (Sweet).—Plant out on a south border.

Mustard.—Sow successions.

New Zealand Spinach.—Plant out in the end of the month.

Onions.—Sow in the beginning of the month, for pickling. Hoe, thin, and weed.

Parsnips.—Hoe, and thin out to 8 inches or 1 foot apart.

Pease.—Top the early sorts, such as the Early Frame, when they come into bloom; draw a little earth to those just above ground. Sow successions, and some of Knight's Dwarf Marrow, at the end of the month, for a late crop.

Potatoes.—Hoe between the rows, and earth-up such as are above ground.

Purslane.—A little more may be sown.

Radishes.—Make successional sowings in a shady situation.

Rampion.—Sow about the end of the month, on a shady border of rich earth.

Rhubarb.—Remove flower stalks as they appear.

Salsafy.—Make a successional sowing.

*Savoy*s.—Sow for the latest crops.

Scorzonera.—Sow a little more in the course of the month.

Spinach.—Sow successions. Thin out advanced crops, and clear ground of winter crops.

Tomatoes.—Plant out against a wall in the end of the month.

Turnips.—Sow Early White Dutch, or other early sorts, for summer use. Thin out crops sufficiently advanced.

II.—HARDY FRUIT DEPARTMENT.

Wall trees must now be carefully inspected, as the shoots will indicate, by their respective degrees of vigour in pushing, the parts of the tree to which a superabundant flow of sap is tending. There is little danger of this in the horizontally inclined branches of fan-trained trees; but with respect to those that are vertically situated, early attention is necessary. The shoots on these, if not checked, will soon monopolize an undue share of sap; an equal distribution of it should be aimed at, if we wish to maintain the regularity, health, and productiveness of the trees. The more shoots and leaves there are on any branch, the more abundant will be the flow of sap through that branch towards them, and that at the expense of the less favourably situated branches. Therefore, all shoots not wanted in the more vigorous parts of the tree should be early removed; those on the weaker parts should be sparingly dealt with, for, whilst they can be left, they tend to establish a stronger flow of sap in the direction most desirable. Shoots that must be left on strong parts, and likely to become over-vigorous, should be stopped when about 6 inches in length, in order to form two shoots of moderate strength. Train and nail shoots as their growth requires. Thin apricots, if not previously done sufficiently; also peaches and nectarines. Syringe the trees frequently, early in the morning if the nights are cold; but otherwise commence about four in the afternoon. Use means, previously recommended, to keep the trees clear of insects. Apply sulphur for mildew. Pick off all curled and blistered leaves. Examine the state of the border, and see that it is sufficiently moist for the roots. Remove suckers. Weed and water strawberry plantations. Syringe grafts with a fine rose. Secure the shoots of budded trees.

III.—FORCING DEPARTMENT.

Basil.—Plant out in the end of the month.

Egg Plant.—Those sown in March should now be shifted into larger pots for fruiting under glass, or planted out in a warm situation, at the end of the month.

Endive is apt to run early to seed if it linger in vegetating; therefore, if the ground be cold out of doors, sow in a tolerably brisk heat, but give plenty of air when the plants appear above ground.

Gourds.—Harden off, and plant out.

Kidney Beans.—Harden off, for planting out, as soon as the weather is favourable.

Mushrooms.—Maintain a steady temperature, and keep the air of the house moist, so that little water may be necessary.

Tomatoes should be almost fully exposed, in order to harden off for planting out towards the end of the month. They should be protected for some time after planting out, if cold nights ensue.

Cucumbers.—Maintain a steady bottom heat, and take care that the air in the frames do not at any time get too cold, more especially when cold weather sets in after a series of warm days and nights; for in this case the plants will more readily exhibit the effects of the change. Unless these effects are counteracted by additional covering, fruits that are making rapid growth will be checked, after which they will not become handsome, although their growth may be resumed under favourable circumstances. Inspect every shoot, and consider what will be the consequence of leaving it, as regards space, in the frame; and if it can be possibly foreseen that there will not be room for it, remove it at an early stage. By so doing, regularity will be easily and advantageously maintained. Stop, as before recommended. Sow, in the beginning of the month, for planting out under hand-glasses.

Melons.—Continue to stop laterals, and set blossoms. Remove all sickly leaves, and see that there be no excess of dryness, either in the soil or in the air of the frame. If red spider appear, no time should be lost in adopting means to prevent its increase. If moisture is raised when the air of the frame is at a lower temperature than the soil in which the roots are, the moisture will soon evaporate, and leave the plants dry, because they will be warmer than the vapour. On the other hand, if vapour be raised when the air of the frames is of a higher temperature than the bottom heat, the moisture will remain condensed on the plants, so that the insects

cannot thrive. Where the fruit is swelled, and commencing to ripen, water must be almost entirely withheld, otherwise the flavour would be deteriorated. The fruit should be placed on a tile, and well exposed to the light. Shade only when absolutely necessary. Plant out for late crops, and for these some may be sown.

Pine Apples.—Maintain a steady bottom heat of about 84°. The air in the fruiting house may range from 75° to 85°, and it may rise to 95° by sun-heat. Shift finally those intended for autumn and winter fruiting, such as the Cayenne and Black Jamaica. In order to insure their starting, gradually reduce the moisture and increase the heat.

Succession plants may now be allowed plenty of heat and moisture, to promote vigorous growth; but, at the same time, care should be taken that it is not so rapid as to be, in consequence, unsubstantial. If this is likely to be the case, the temperature at night should be lowered to between 65° and 70°, with a freer admission of air in the day. Sprinkle the paths, and syringe overhead soon after three P.M., all except plants that are ripening off their fruit. Shut up immediately after, and closely, if the temperature be not more than 90°. Give manure water alternately with pure water. Shade slightly in very hot sunshine.

Shift succession plants at any time when their roots require more room. Remove suckers. Collect rich fibrous soil, and if placed where sheep can be inclosed upon it for some time, it will be rendered the more valuable; otherwise it should be mixed up with pigs' dung.

Vines.—Fire-heat will be required to maintain a progressively increasing temperature. In houses where the grapes are approaching maturity, the temperature at night should not be less than 70°, and it may be allowed to rise to 85° in the day, or 95° by sun-heat. Muscats should have, both night and day, a temperature at least 5° higher. When the grapes are ripe, the temperature should be lowered, with the view of keeping the fruit from shrivelling. The later vineries will require but little fire-heat in fine weather. Give a little air when the temperature rises above 70° in the morning, and increase as the heat of the day renders necessary. Syringe, and shut up in the afternoon with a temperature of 90° to 95° by sun-heat. Continue to

tie in shoots as they advance in growth. Stop laterals, as before directed. When the shoots reach the top of the house, it will, in most cases, be necessary to stop them; but, before doing this, take care that one or two laterals, immediately below where the shoot is to be stopped, are left unstopped, to take the flow of sap, which, deprived of its leading channel, would otherwise be directed to the eyes lower down, and cause them to break into laterals, instead of remaining to push fruit-bearing shoots in the following season. Retain on each plant as much foliage as can be well exposed to light, and no more. If the nights are mild, vines may be planted. Mulch over the roots with stable manure. Shift vines in pots; and after they make fresh roots water with manure water. See that vine borders are sufficiently moist.

Figs.—Maintain generally a moist atmosphere; syringe frequently, except when the fruit is ripening. Water with manure water occasionally, but not if the plants are growing too vigorously. Take care that the plants do not suffer one hour for want of water.

Peaches and Nectarines.—When the fruit is stoned, the temperature may be safely raised to 60° minimum, and 75° maximum, or with sun-heat to 90°, plenty of air being given at the same time. Continue to tie in the shoots, and shorten the terminal shoot of bearers to 3 or 4 inches, thus affording more space to the succession shoots; but do this by degrees, commencing at the upper part of the tree. Syringe frequently, till such time as the fruit is ripening, and shut up rather closely immediately after; but a little air should be kept on, even at night. Examine the borders, so that, if necessary, they may be rendered sufficiently moist before the fruit begins to colour; for if not done before that takes place, it cannot afterwards, without affecting the flavour of the fruit.

Cherries.—Give plenty of air, but water sparingly as the fruit approaches maturity. When the fruit is gathered, remove the trees, and attend well to their being frequently syringed, and regularly watered.

Strawberries.—Introduce the latest succession, and attend to former directions.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Continue to roll and mow lawns; weed, and keep the beds and borders raked. Plant

out dahlias; also, in favourable weather, pelargoniums, petunias, verbenas, calceolarias, fuchsias, salvias, and other bedding-out plants.

Sow annuals and biennials. Train creepers. Bud roses, and keep the plants clear of suckers. Stick carnations, and other plants that require support.

If the whole bed or border be watered, the plants will thrive better than would be the case if water were applied merely to the root of each.

V.—PITS AND FRAMES.

Many of the bedding-out plants may now be turned out, so that a considerable amount of space in these structures will be available for the reception of sowings of tender annuals for autumn flowering, and for cuttings of plants which it is desirable to propagate.

Antirrhinums.—Shift. Plant out.

Auriculas.—After flowering, place the pots in a cool situation, and protect from heavy rains. Shift seedlings.

Balsams.—Sow for late flowering.

Calceolarias.—Shift for large specimens; train and support the shoots as they advance.

Carnations.—Remove decayed leaves; top-dress, and stick. Prick out seedlings.

Cinerarias.—Select some pots of the finest varieties, and place on finely-sifted ashes in a frame, where they should only be protected from rain. Propagate from rooted slips, if necessary.

Dahlias.—Harden off, and plant out the more forward plants. Pot off later struck cuttings.

Fuchsias.—Continue to shift, where large specimens are desired.

Heart's-ease.—Let the frames now face the north. Remove the lights entirely during favourable weather. Propagate by cuttings.

Petunias.—If the flowers in some of those in pots are pinched off as they appear, and the shoots topped, a late bloom will result, forming a succession.

Phlox.—Various kinds may be propagated by cuttings.

Roses, in pots, must be kept well watered, and precautions taken against the green fly.

Verbenas.—Harden off for planting out after the middle of the month, if the weather be then favourable.

VI.—GREEN-HOUSE.

If warm weather should occur in the early

part of the month, air should be most abundantly admitted, in order that the plants may not be exposed to too high a temperature, previous to many of them being turned out in the end of this, or beginning of next month. Air should be admitted during the nights, if these are mild. After flowering, heaths may be removed to cold pits; and bulbous plants should be placed on a dry shelf till their foliage is completely decayed. As vacancies occur, from partial removals, fill up with plants from pits and frames.

Shift and top-dress, when necessary. Train and pinch shoots, to render the plants symmetrical. Propagate hard-wooded plants when cuttings can be obtained. When the plants wintered in the green-house are generally turned out, it ought to be thoroughly cleaned before it is again furnished with a fresh stock of plants, some of which may consist of various

kinds that can now be properly introduced from the stove.

VII.—PLANT STOVE.

Increase the temperature, and likewise the moisture, so that the growth of the plants may proceed with full vigour.

A high temperature will now be easily maintained with little fire-heat; but a due degree of moisture is often difficult to command. The paths must be kept wet, and the house shut up after syringing in the afternoon. Shade during hot sunshine. Early shifted plants, of rapid growth, will now require to be again shifted. Orchids, generally, should be kept in a uniformly high moist temperature. Care should be taken that the moss, or turfy peat about those on blocks, do not get in a condition likely to throw off the water without being thoroughly saturated.

JUNE.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5°33' W.	59°52	3·32	21
Middlesex..	Chiswick...	51 29	0 18 W.	60°31	1·88	30
Gloucester.	Stroud.....	51 45	2 13 W.	58°00	2·40	30
Lincoln.....	Boston.....	52 48	0 5 W.	61°63	2·31	20
Dublin.....	Dublin.....	53 21	6 11 W.	60°24	...	17
Lancashire..	Liverpool...	53 25	2 59 W.	60°00	...	25
Dumfries...	Applegarth	55 13	3 12 W.	54°77	2·97	19
Mid-Loth..	Edinburgh.	55 58	3 11 W.	57°00	2·60	20
Aberdeen..	Aberdeen...	57 9	2 5 W.	58°49	...	8
Orkney.....	Sandwick...	59 5	3 17 W.	52°69	2·46	26

I.—KITCHEN GARDEN DEPARTMENT.

In former months, protection from severe cold was necessary; but now the effects of excessively hot and dry weather have to be guarded against. Watering becomes an important operation, but recourse should not be had to it in the open ground, so long as the health of the plants is not endangered. When it is absolutely necessary, it should be done effectually, and continued till rain begins to fall.

Let the surface of the soil occupied by crops be frequently stirred and kept loose. Destroy weeds on their first appearance; by so doing, much labour afterwards will be saved.

Asparagus.—Discontinue cutting at mid-summer. Dress beds with manure water or common salt.

Basil.—Plant out on a warm border.

Beans.—In the beginning of the month, a crop of the Early Long-pod should be sown; and about the end, the latest main crop may be put in. Earth up and top advancing crops.

Beet.—Thin to 9 inches apart.

Borecole.—Plant out.

Broccoli.—In the beginning of the month sow the latest spring crop, if not before done. Plant out all crops sufficiently advanced, and give plenty of water, if the weather be dry.

Brussels Sprouts.—Plant out.

Cabbage.—Plant out before the plants get too large and crowded. Sow for coleworts in the third week.

Capsicums.—Plant out in a warm situation, in the beginning of the month.

Cardoons.—Thin out, and keep well watered.

Carrots.—Some may be sown for drawing young. Hoe and thin the more advanced crops.

Cauliflowers.—A few more may be sown, on a rich border, in the beginning of the month, in rows, so that they may be thinned out and come to maturity without transplanting. Plant out successions. Do not allow the plants to suffer from drought; protect heads with leaves.

Celeriac.—Plant out, but not in trenches, in tolerably rich sandy soil.

Celery.—Continue planting out as the plants

attain sufficient size. Give plenty of water. Sow a little in the beginning of the month for late spring use.

Chervil.—Sow a succession.

Cress.—Keep up a succession by frequent sowings.

Cucumbers.—Sow or plant out on ridges for pickling.

Endive.—Sow in the middle of the month.

Kidney Beans.—Sow successions.

Leeks.—Transplant those sown in March.

Lettuce.—Continue sowing and planting out successions. Water frequently in dry weather, and tie up for blanching, as required.

Mustard.—Sow successions.

New Zealand Spinach.—Plant out in the beginning of the month, if not previously done.

Onions.—Sow for drawing young; also some for pickling. Hoe and thin early sown, and break off flower stems from those sown in autumn.

Orach.—Sow about the middle of the month, on rich soil.

Parsnips.—Thin and hoe.

Pease.—Sow, about the middle of the month, Knight's Tall Marrow, in rich well-trenched ground, for late autumn use; also some of the Auvergne, towards the end of the month.

Potatoes.—Earth up.

Purslane.—Sow a little for a succession.

Radishes.—Make successional sowings in a shaded spot.

*Savoy*s.—Plant out towards the end of the month.

Spinach.—Make successional sowings.

Tomatoes.—Plant out, if not already done.

Turnips.—Sow a succession in the beginning, and the main winter crop in the end of the month. Hoe and thin previous sowings as they advance.

are only sufficiently vigorous, whilst those that are weak should be allowed the greatest possible liberty; care, however, should be taken that they are so far inclined to the position they must ultimately occupy, as not to be liable to be broken when brought to it. Train shoots straight from the extremity of the branches, excepting in the case of the lower and horizontally placed branches, the leading shoots of which should have their points turned upwards; and, on the other hand, those in the centre and vertical, or nearly so, if likely to be over-strong, should be nailed zig-zag, after they have attained as much length as it will be necessary to retain at the winter pruning. Shorten, to about 3 inches, the leading shoots of such fruit-bearers as will not be required for leaders. This may be deferred till after the fruit is stoned, if the tree is thin of branches and foliage; but otherwise it may be done earlier.

Pear trees on walls should have their fore-right shoots pinched or cut back to 6 inches, always commencing at the upper part of the tree, at least a week before the lower part is interfered with, so as to check the growth, and consequently the flow of sap to the upper part. The same principle should be acted upon in the case of the apple, plum, and cherry; and not only as regards those on walls, but likewise those trained as espaliers. The most luxuriant shoots of standard and dwarf fruit-trees should also be pinched, where it is evident that, if let alone, they would, by the end of the season, acquire a degree of strength inconsistent with that of the branches in other parts of the tree.

In nailing in the shoots necessary to be retained, take care that the shreds are not too tight. The nails should be driven only in the mortar, and in it no farther than is just sufficient to take slight hold. Let none be driven so near the young fruit as to be likely to touch or gall the latter when it becomes full-grown; and, on the same account, many nails employed in the winter nailing, will require to be drawn when fruit happens to be too near them.

Syringe wall trees frequently, commencing after four P.M. Use powdered tobacco leaves or snuff against the green fly.

Water, at the root, trees planted last spring, and others that may require it, before they suffer from want of moisture. Yet cold spring water must not be used, especially for wall

II.—HARDY FRUIT DEPARTMENT.

Particular attention must be directed to the summer pruning of wall trees, otherwise confusion will take place, and the sap will flow most where it is least wanted; so that a tree which, by proper management, would be everywhere sufficiently, and almost equally vigorous, will exhibit the evil of over-luxuriance in one part, and excessive debility in the other.

With respect to peaches and nectarines, the succession shoots must be well attended to. Those that are likely to become too strong must be nailed in earlier than those which

borders, for much cold water applied to the roots of trees growing in them will stop the swelling of the fruit, and cause it to crack.

Attend to trees grafted last spring, and if they are growing freely, the clay will require to be removed, and the tying loosened. In many cases the grafts must be again retied, and the shoot supported by a small rod. Remove shoots from stocks below shoots from grafts or buds.

III.—FORCING DEPARTMENT.

Egg Plant.—Keep this near the light; attend to watering, and guard against red spider.

Mushrooms.—Prepare spawn. Sprinkle beds if the heat is too great, allowing a little air at the same time, so that coolness may be produced by evaporation.

Cucumbers.—Attend to former directions respecting stopping and training. Shade from too hot sun, especially when the foliage is moist, and give plenty of air. Water abundantly and frequently with manure water. When the external temperature is above 75°, with a moist atmosphere or gentle rain, the sashes may be drawn off. Plants in ridges should be stopped, to furnish a sufficient number of shoots, from near the stem.

Melons.—The linings should be kept in condition to afford a command of heat in case of cold and cloudy days. In such weather, covering at night will be necessary; but it may, towards the end of the month, be discontinued if the nights are very mild; and even in that case a thin covering is useful, for it prevents the glass from becoming so cold as it otherwise would, and consequently renders it incapable of acting as a condenser of the moisture contained in the warmer air of the frame, thereby drying the air for the benefit of the red spider, and causing drip, to the injury of the foliage. Water abundantly whilst fruit is swelling; take care that the soil is effectually moistened just before ripening commences, for when it does, no more water ought to be given. Place tiles below the fruit.

If the earliest beds are cleared of fruit, some fresh soil should be added, and, presuming that plants have been properly forwarded, they may be introduced for a late crop. In some cases, when the plants that have borne a crop are healthy, they may be cut back a few joints, and 2 or 3 inches of fresh soil spread

over the surface of the bed, the bottom heat raised to 84°, if it has declined, and the plants started afresh.

Pine Apples.—For the succession plants, as well as those that are swelling fruit, abundance of heat and moisture should now be supplied. Syringe the plants, and all the interior of the stove or pit towards evening, and then shut up. Fruits that are ripening should get very little water. Remove suckers, except such as may be required for propagation. Supply liquid manure once or twice a-week. Take the opportunity of mild dull weather to shift any plants that require it.

Vines.—The temperature may now be 70° at night, 75° to 80° through the day, and for Muscats 85° or 90° by sun-heat. A constant circulation of air is so essential, that, in order to afford it, without lowering too much the temperature, a little fire-heat will still be necessary, except in very hot weather. But whilst plenty of air is recommended, sweeping draughts must be guarded against. Houses containing ripe grapes must be kept dry and well aired. Water must not be applied to plants ripening fruit; but in case of red spider the paths should be frequently watered. When the fruit is gathered, the foliage should be well syringed. Water the borders with manure water, but not after the fruit begins to colour. Vines in pots should also be supplied with manure water. Attend to stopping the shoots, and expose the foliage to as much light as possible.

The vineries for very late crops will require little or no fire-heat, except, perhaps, when in flower, if the nights are colder than usual at this period of the year. Stop and regulate the shoots, as previously directed for early crops. Continue to thin the berries, and tie out the shoulders of bunches requiring that operation.

Figs.—No greater extent of shoots, nor quantity of foliage, should be encouraged than is proportionate to the size of the pots. If there is a large surface of leaves, the evaporation from them will soon exhaust all the moisture which the soil in a pot can contain, and in a short time the fruit is in danger of becoming yellow from being exposed to alternate vicissitudes of dryness and moisture. The shoots should, therefore, be pinched, in order that the evaporating surface may be limited, and thus render the supply of moisture less precarious.

Peaches and Nectarines.—When the fruit is ripening, the leaves should be turned aside so as to expose it to the sun, in order that it may acquire a fine colour. Attend to the training in of young shoots for next year's bearing; and, in order to give them more space, some of the present year's bearers may be cut back to the succession shoot at the base as soon as the fruit is gathered. When the crop is all off, let the trees be well syringed, and all laterals removed, by cutting them off above the first joint at the base.

Cherries.—The trees that have been forced should be occasionally supplied with manure water, and the foliage should be kept clean by syringing.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

The lawns must be kept regularly mown, swept, and rolled; the walks neatly edged, kept free from weeds, and well rolled, especially when just sufficiently moist after the subsiding of heavy rain. Such of the plants in borders as require support should be stuck and neatly tied up, those that are of a dwarf-spreading habit should be trained and pegged. The stalks of any plants that have done flowering should be cut down, except in some cases where it is advisable to save seed. Take up bulbs when the leaves are fully decayed. Plant, from reserve stock in pots, such kinds as will best occupy vacancies caused by the above-mentioned removals, and maintain the proper variety of colours. Where the surface of the ground is necessarily disturbed by these operations, let it be immediately regulated and raked over. Stir the surface elsewhere when it appears hard, but chop rather than rake off clods that would naturally crumble down when moistened, or they may be softened by watering, and then, when in a friable state, raking will be easily and well accomplished. Annuals will require to be regularly watered in very dry weather, and all trees and shrubs removed since last autumn must be observed, to see that they have sufficient moisture. Mulching the surface round these would have an unsightly appearance; but, in particular cases, a portion of the soil may be removed, and the mulching put in its place, and well watered. This mulching may be soon afterwards thinly covered over with soil. Before the stalks get too hard, make cuttings of any biennial, or other herbaceous plants, which it

may be desirable to propagate, such as lych-nis, double rockets, double wallflowers, antirrhinums, &c., and, towards the end of the month, commence layering pinks and carnations. Bud roses, clip hedges and box edgings.

V.—PITS AND FRAMES.

The bedding-out plants reared in these will now be chiefly turned out, and space will thus be afforded for potted-off seedlings, and for cuttings of green-house plants, choice biennials, and perennials. Shading will at times be necessary, and watering must be duly attended to.

Auriculas.—Shade slightly; gather seed; pot off seedlings.

Calceolarias.—Sow as soon as the seeds are well ripened. Cut down the stalks after flowering, and place the plants in a cool situation, but protect from rain.

Chrysanthemums.—Shift before the plants get pot-bound. Water abundantly, and occasionally with manure water.

Cinerarias.—Sow in fine soil as the seed ripens. Propagate by cuttings.

Fuchsias.—Syringe frequently plants not yet in flower; those which are will occasionally require to be shaded.

Heart's-ease.—Save seed. Put in cuttings whilst young; they will strike in a north border.

Hollyhocks.—Towards the end of the month propagate by side shoots, taking them off as soon as they can be inserted in the soil of a frame, which should be placed in a cool shaded situation.

Pelargoniums.—Propagate by cuttings; stop these when they have made three or four eyes.

Roses (in pots).—Prune off flower-stalks immediately after the flowers decay. Top-dress the plants, and place out of doors, for autumn flowering; but, if intended to be forced, the flower-buds must be pinched off as they form. Propagate China roses by cuttings.

Verbenas.—Propagate for replacing annuals after the latter have flowered.

VI.—GREEN-HOUSE.

In the course of this month, sooner or later, according to the state of the weather, all the plants intended to stand out of doors for the summer may be turned out from the green-

house, which should, however, be kept gay with successions of plants in flower from the pits and frames, and occasionally from the stove. In order that the flowers may continue longer in perfection, a screen of some thin material should be employed during bright sunshine, or at least from eleven A.M. to three P.M. Plants retained in the house for the purpose of rearing for fine specimens, should have the flowers pinched off as they appear, until the plants grow to an eligible size for flowering. Pelargoniums that are getting out of flower should be cut back and the shoots propagated. Many of the heaths may be removed to the pits and frames to recover after flowering; and if mildew appear apply flowers of sulphur. Propagate heaths by cuttings, and also other hard-wooded plants, as soon as the young shoots are fit. Abundance of air must be allowed. If any stove plants have been introduced, it will be necessary to shut up in the evening.

Green-house plants, turned out of doors, should be carefully looked after, in order that they may not suffer for want of water; nor, on the other hand, from its stagnation. When water is observed to stand on the surface of

the soil in any of the pots after rain, let the plants in all such cases be immediately shifted.

VII.—PLANT STOVE.

Artificial heat will now be scarcely necessary, but, whilst more air than was formerly given will be requisite in hot weather, the evaporation will be consequently increased; and, therefore, additional precaution must be taken to keep the air of the house sufficiently moist. The plants should be syringed overhead early in the morning, and in the afternoon. In hot sunny days water should also be thrown along the paths. Shading from the more direct rays of the sun will prove beneficial, and for orchids it is especially necessary. These plants will require plenty of water whilst making their growth, but as they approach maturity less should be given.

Plants of rapid growth will likely require to be shifted. Propagate such plants as it is desirable to increase when cuttings can be obtained.

Prune and train creepers, and regulate the growth of plants generally, by stopping luxuriant shoots, so as to produce others necessary to form handsome specimens.

JULY

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	62.10	2.06	21
Middlesex...	Chiswick...	51 29	0 18 W.	63.11	2.55	30
Gloucester...	Stroud.....	51 45	2 13 W.	61.30	2.94	30
Lincoln...	Boston.....	52 48	0 5 W.	63.01	2.58	20
Dublin...	Dublin.....	53 21	6 11 W.	61.47	...	17
Lancashire...	Liverpool...	53 25	2 59 W.	61.41	...	25
Dumfries...	Applegarth...	55 13	3 12 W.	57.09	3.93	19
Mid-Loth...	Edinburgh...	55 48	3 11 W.	61.00	3.00	20
Aberdeen...	Aberdeen...	57 9	2 5 W.	60.47	...	8
Orkney.....	Sandwick...	59 5	3 17 W.	54.93	2.69	26

I.—KITCHEN GARDEN DEPARTMENT.

In some seasons, this month is excessively hot and dry; in others, heavy thunder-showers fall at intervals, and occasionally it is wet almost throughout. In the first case, it will be obvious when watering is necessary; but sudden heavy rains are often deceptive, for they may run off by the surface without reaching the extremities of the roots of plants, and frequently the air becomes drier after these heavy falls than it was before. Under these circumstances vegetation is more apt to suffer than if the drought had been continuous; and,

therefore, watering must be more especially attended to after such rains as do not effectually moisten the ground to a sufficient depth.

Herbs that are fit should be cut and dried; and, towards the end of the month, some other crops will probably be sufficiently matured for being taken up to dry for housing.

American Cress may be sown on a shaded border.

Beans.—The latest crops should be sown early in this month, if not before done. Earth up former sowings as they advance, and top as they come into flower.

Borage.—A small quantity may be sown for a succession.

Borecole.—Plant out, 2 feet apart, as the plants become fit.

Broccoli.—Finish planting out the principal crops for winter and spring use. Sow Walcheren about the middle of the month for a late spring crop.

Brussels Sprouts.—Plant out principal crops for winter use.

Cabbages.—Plant for autumn use. Sow in the first week for coleworts if not before done. The principal sowing of Early Battersea or Vanaek, for autumn planting, should be made generally in the last week; also Red cabbage. But in late situations these sowings ought to be made about the middle of the month. Hoe advancing crops, and in exposed situations draw a little earth to the stems.

Cardoons.—Thin the patches so as to leave only the best plant in each. Hoe and water in dry weather.

Carrots.—Sow some of the Early Horn, in a shaded situation, for drawing young. Thin principal crops to 6 inches apart in the rows.

Cauliflowers.—Plant out for May sowing if sufficiently advanced.

Celeriac.—Plant out in the beginning of this month, if not done in the last.

Celery.—Plant out for main crops for autumn and winter supply. Water abundantly. Earth up early crops when the plants are dry, taking care that the earth is kept from the heart of the plants.

Chervil.—Sow a succession for autumn use.

Chicory.—Sow in the beginning of the month on trenched ground.

Corn Salad.—Another sowing may be made.

Cress.—Sow successions.

Cucumbers.—Water those planted on ridges, and for pickling, with water not colder than 60° to 65°; therefore, spring water should not be employed till it has been exposed in tubs to the heat of the sun, or otherwise raised to the proper temperature.

Endive.—Sow in the middle and end of the month for the principal winter crops. Plant out successions.

Garlic.—Take up when the leaves begin to decay; dry in the sun, and store in a dry place.

Gourds.—Water in dry weather. Peg down the long shoots of Vegetable Marrows, so that they may root at the joints, and continue longer in bearing.

Kidney Beans.—A few of the Black Belgian may be sown early in the month, for a late supply.

Leeks.—Plant out and hoe.

Lettuce.—Sow, and plant out successions.

Mustard.—Continue sowing successions.

Onions.—Take up and dry Potato onions.

Parsley.—Sow about the middle of the month. Remove flower-stalks. Thin Ham-burgh to about 9 inches apart.

Pease.—The latest sowing, including

Knight's Tall Marrow, should be made in the first week. Stiek, and hoe between the rows of advanced crops.

Potatoes.—Chapman's Kidney should be planted for late young potatoes. Earth up where not before done.

Purslane.—Some may be sown for a late supply.

Radishes.—Sow successions in a cool situation. The Black and the White Spanish should be sown towards the end of the month for winter use.

Rocambole.—Take up, and treat in the same way as garlic.

Salsafy.—Thin, and break off flower-stems as they form.

Savoy.—Finish planting out principal winter and spring crops as soon as possible.

Scorzonera.—Thin, and break off flower-stems.

Shallots.—Take up when the leaves begin to decay, dry in the sun, and store in a dry place.

Spinach.—Make a successional sowing.

Tomatoes.—Pinch off the tops. Thin and train the shoots.

Turnips.—If not before done, the main winter crop should be sown in the beginning of the month. Hoe, and thin sufficiently advanced crops.

II.—HARDY FRUIT DEPARTMENT.

Continue to reduce the superabundant shoots of wall-trees, according to the gradual mode previously recommended. Spur-leaves, and those at the bases of the shoots of pear trees, should be of a healthy dark green colour. This cannot be the case if they are shaded by superfluous shoots. Therefore, where several shoots spring from nearly the same point, cut them clean out, with the exception of one or two, and these may now be shortened to six eyes. The same observations and mode of proceeding apply to apples, plums, and cherries, with the exception of the Morello, which bears next year on the shoots formed in the present. Continue to lay in the succession shoots of peach and nectarine trees, shortening, at the same time, others having fruit at their bases, to 3 inches. If any shoots in these trees are becoming over-vigorous, shorten them to a suitable lateral for forming a weaker leader. Other laterals should be cut back, but not closely to the shoot from which

they spring; for, if closely cut, the bark of the shoot is apt to become blotched. The laterals should be cut back a little above their first pair of leaves. Syringe after four P.M.; and apply snuff or powdered tobacco leaves for the destruction of green fly, and sulphur for mildew as soon as it appears. Borders, especially those well drained, will require to be examined; and if becoming too dry they must be watered. If the surface be mulched with long dung, it will not only render less water necessary, but will, at the same time, enrich the soil, and contribute to the swelling of the fruit. Rain, when it falls heavily, is apt to run off by the surface from smoothly raked sloping borders. This should be prevented by forking, or furrows may be made lengthwise.

Bud, in the first place, cherries and apricots; then plums, peaches, and nectarines, and other fruit-trees, as the buds are fit, and the stocks in proper condition. Attend to the untying and supporting of grafts. Layer strawberry runners for forcing; this may be done in 3-inch pots filled with richly prepared compost. Press a joint of the runner into the soil, and place a small stone upon it. Pinch the extremity of the runner beyond the pot, and water when necessary. Runners, to form plants for a new plantation, should also be stopped, when two or three of the first joints have struck root; but all runners, not required for forcing or for new plantations, should be cut off as they push, or say once a week.

III.—FORCING DEPARTMENT.

Mushrooms.—Make beds for autumn and winter bearing. Keep the atmosphere moist by sprinkling the floor of the house and coverings of the beds.

Cucumbers.—Continue to thin, stop, and regulate shoots. Give manure water occasionally, and when this is done let the foliage be immediately syringed with pure water. In dry weather it will be difficult to maintain a moist atmosphere in the frames. Endeavour to do so by frequent watering, and shading during the hot period of the day.

Melons.—When the fruit is nearly full-grown, let the bed be well watered, so that the plants may not suffer from drought, till the ripened fruit is cut; then another watering may be given, if necessary. Where hot water pipes are employed for heating, a regu-

lar quantity of moisture in the soil is difficult to command; but with regard to dung-beds there is no difficulty in doing so. In fact, when the fermenting materials are duly prepared, the whole being sufficiently moist when put up, water will scarcely be required from the time the roots enter the moist decomposing mass till the fruit is ripe. Bottom heat ought still to be at command in case of dull weather, and, therefore, the linings must be kept turned, and partially renewed, as may be found necessary. Attend to stopping the laterals and setting the fruit. The plants, if not subjected to confinement, would naturally extend in all directions, and each leaf would be exposed to the light; by stopping, training, and judicious thinning of shoots, this should be the case with plants artificially limited within pits and frames.

Pine Apples.—When succession plants fill their pots with roots, they should be shifted into their fruiting pots. Take the plants out and repot them, without shaking off any of the draining substances that may adhere to the bottom of the ball. If the bed is too hot, it is a good plan to plunge an empty pot mouth upwards, and on this rest the pot containing the plant. The mouth of the lower pot should be narrower than the bottom of the upper. By removing the tan from contact with the bottom, the roots will be in a temperature much the same as that of the air of the house, and, as the bed falls below 90°, the tan, or other heating material, should be closed round the pot. Black Jamaica, and other winter kinds, will require the above-mentioned degree of bottom heat. Syringe over the foliage two or three times a-week, excepting those plants that are ripening their fruit. Plant crowns and suckers in 3-inch pots as soon as their ends, where twisted off, become dry.

Vines.—Vineries in which the fruit is ripe should be kept dry. Those in which the fruit is swelling should be frequently syringed, in order that a healthy foliage be maintained free from red spider; for if this pest is not kept down before the fruit begins to ripen, it cannot possibly be eradicated till after the crop is gathered, and by that time a great amount of injury will have been caused to the vines, as regards their future prosperity. The foliage of the vine, when healthy, evaporates a deal of moisture, and this is unfavourable to the red spider; but if the roots are in too dry a medium, evaporation by the foliage cannot

go on, and insects, under this circumstance, thrive exceedingly. Endeavour, therefore, to preserve a due degree of moisture in the border, in order that the foliage may be fresh and healthy, even when the fruit is ripe. Laterals may be allowed to grow after the crop is gathered at this early season, in order that they may contribute to the formation of roots.

Figs.—Under glass the fig tree will bear a second crop—that is, on the wood formed in the current year. When the shoots have grown so that five or six figs have formed, pinch the end buds. Water regularly, and syringe the foliage. Abundance of air should be given during the day, and a little at night.

Peaches and Nectarines.—As the crop approaches maturity, all watering must be withheld, and a dry, hot, well-ventilated atmosphere should be maintained. Let the ripening fruit be fully exposed to light, by turning aside any leaves that would otherwise shade it. In gathering, very little force should be necessary. Let the base of the fruit be surrounded by the soft tips of all the four fingers and thumb, and the amount of pressure thus applied on five places will be so slight on each that no bruising will result. When the crop is gathered, water the border if necessary, and syringe well the foliage.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Continue to mow, sweep, and roll lawns; and if the weather be such as to cause a portion of the latter to commence being sun-burned, take the opportunity of a dull cloudy afternoon to give a thorough watering. When any of the walks become so dry as to have a loose surface, let them be watered, so that the loose gravel may be firmly rolled in, and a smooth surface restored. If dandelions spring up, they may be destroyed by cutting off the tops as close to the ground as possible, and putting a pinch of salt on the top of the root. Daisies should have the flowers taken off with a daisy-rake.

Watering should be well attended to; the surface of all borders and beds should be frequently hoed and raked, so as to have a fresh, clean appearance. Clip all kinds of hedges; prune and regulate evergreens that are extending beyond proper limits; this may be so done with the knife as not to have a shorn appearance. Train creepers, and tie up flowering plants; remove the decayed flowers

of shrubs, and the decayed stems of herbaceous plants. Take up bulbs as their leaves wither. Clear off annuals when past flowering, except when it is desirable to save seed, and fill up the vacancies with verbenas, petunias, pelargoniums, and other plants kept in reserve for the purpose.

Propagate, by layering, carnations, sweet-williams, roses, and other flowering shrubs; and by cuttings, various perennial plants, pinks, carnations, double wallflowers, heart's-ease, and antirrhinums.

Bud roses, and other ornamental trees and shrubs usually propagated by that mode; attend to loosening the ties of buds, and remove suckers from stocks.

V.—PITS AND FRAMES.

These can now be emptied in successive portions, the lights painted, and the pits themselves thoroughly cleaned, whitewashed, and fumigated with sulphur, taking care, however, that they are fully exposed to the air previous to their being refilled. Pot off seedlings and rooted cuttings before the roots get matted. In hot weather, shading will be necessary. In warm, moist weather, many of the plants may be fully exposed to gentle rain. Abundance of air should be given, and care should be taken that the plants do not suffer from want of water. If the leaves of any plant are not of their natural hue, let the plant be gradually brought near the light; and if it do not then recover, it should be repotted immediately.

Antirrhinums.—Propagate by cuttings in a close frame, or under a hand-glass.

Azaleas.—In the beginning of the month, inarch Chinese varieties upon the more hardy.

Calceolarias.—Sow seeds in light sandy soil. Continue to propagate by cuttings.

Camellias.—Propagate in the beginning of the month, by inarching and grafting.

Carnations.—Put in pipings under hand-glasses with a little bottom heat, which will cause them to root more readily.

Cinerarias.—Propagate by offsets, or by cuttings in sand; place the pots in a cool frame.

Heart's-ease.—Propagate by cuttings.

Pelargoniums.—Continue to propagate by cuttings; those of the more choice sorts should be potted singly.

Phlox.—Propagate under hand-glasses, or in pits.

Pinks.—Propagate by cuttings, which will quickly strike root if placed under bell-glasses, on a very slight bottom heat. Seed-pods should be ripened under hand or bell glasses, if the weather be wet.

Polyanthus.—Propagate by division towards the end of the month. By performing the operation at this period, the plants have time to get well established before winter. Take up and separate the old plants; shorten the tap-roots to within half an inch of the base of the leaves, and replant in a compost of turfy loam and leaf-mould, with a little well-decomposed cow-dung. Afterwards the bed should be well watered. Sow seed.

Primroses (Chinese).—Sow as soon as the seeds are ripe, for plants to flower next spring. Shift young plants.

Roses.—In many cases it would be desirable to shade some of the finest blooms from hot sun. Liquid manure may also be given to the autumn flowering varieties, especially those which do not open freely. Frequently one or two over-luxuriant shoots start up and attract the greater portion of the sap; such ought to be checked, for the general benefit of the plant, both in the present and following seasons.

VI.—GREEN-HOUSE.

Plants more tender than those turned out last month may now be removed from the green-house to a sheltered situation, placing the pots on a layer of sifted coal ashes. They should be replaced by blooming plants, annuals and others, from the pits and frames. The house should be kept well aired, and attention must be paid to shading when the sun is strong. Excepting those in flower, the plants should be frequently watered over-head. The soil in the pots should be kept free from moss, and occasionally refreshed with a top-dressing. The same remarks apply to the plants standing out of doors. Shift as the growth of any plants renders the operation necessary. Fumigate if green fly make its appearance; do this two nights in succession, in order to make sure. Dust heaths, and other plants, with flowers of sulphur, if the least symptom of mildew can be discovered. Propagate any green-house plants that it may be necessary to increase. Cuttings of cactuses, and other succulents, should not be put in till the cut is dry. Bud or graft orange trees; thin the

fruit of these, in order that the trees may be the better enabled to grow and produce flowers, the latter being far more valuable than the fruit. Give manure water occasionally. It ought to produce a dark green foliage; but if it has not that effect, let the plants be carefully shifted, and put in a bottom heat of 70°. Pinch off the tops of shoots that are making too much growth in comparison with others on the same plant. In some cases, it will be necessary to stop all the leading shoots of the plant, in order to keep it dwarf.

Pelargoniums that are past, or nearly past flowering, should be exposed to sun and air, to ripen their wood previously to cutting down; but, a little before and after this is done, let the soil in the pots be dry. When the cuts are dried, and somewhat healed over, give the plants a little water, and keep them closer and warmer till they break.

VII.—PLANT STOVE.

In consequence of the increased amount of light resulting from the comparatively great elevation of the sun in summer, and with suitable heat and moisture, stove plants will have made shoots under circumstances favourable to their natural constitutions. This growth should now be rendered firm by admitting air more freely, and limiting, but with due caution, the supply of water. The foliage will now bear more sun, and, therefore, less shading should be employed; this will also tend to the formation of flower-buds. Commence to give air when the temperature by sun-heat rises above 70°; but shut up in the afternoon with a temperature of 90°, and it should not fall below 65° at night. Syringe frequently, in order to keep the foliage clean, and fumigate when necessary. Musas, Granadillas, Guavas, or other tropical plants bearing fruit, should be watered occasionally with manure water, and plants that are flowering abundantly may also be assisted in the same way. Propagate by cuttings as may be found necessary, but the earlier in the month the better, in order that the plants may get well rooted and established before winter. Pot off seedlings.

Orchids.—Keep up the temperature and moisture. Syringe daily when the weather is warm, and give air to prevent the plants from being too succulent. Shift *Aërides*, *Saccobiums*, *Vandas*, and others, when past flowering.

AUGUST.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5°33' W.	61.11	3.28	21
Middlesex...	Chiswick...	51 29	0 18 W.	61.97	2.41	30
Gloucester...	Stroud.....	51 45	2 13 W.	60.50	2.49	30
Lincoln.....	Boston.....	52 48	0 5 W.	61.29	2.41	20
Dublin.....	Dublin.....	53 21	6 11 W.	61.40	...	17
Lancashire...	Liverpool..	53 25	2 59 W.	62.00	...	25
Dumfries...	Applegarth	55 13	3 12 W.	56.50	3.55	19
Mid-Loth...	Edinburgh.	55 43	3 11 W.	57.50	2.70	20
Aberdeen...	Aberdeen...	57 9	2 5 W.	59.64	...	8
Orkney.....	Sandwick..	59 5	3 17 W.	55.08	2.70	26

I—KITCHEN GARDEN DEPARTMENT.

Attention must now be paid to the sowing of certain crops for autumn, winter, and spring. The exact time is of more importance than it is in the case of spring sowings. At that time a week sooner or later is sometimes of little consequence; but in this month there are particular times at which, almost to a day, certain crops must be sown, otherwise they will not attain full perfection. If sown a week too early they will be apt to run to seed, and if as much too late they will not become full-sized. The proper times for the respective sowings varies, however, according to the soil and climate, and that which might be a proper time on the average of seasons, in any locality, may not be so in particular seasons. The gardener should, therefore, study well these matters, and act accordingly. He should, moreover, take the precaution, in the case of seed-beds at least, of sowing at the times hereafter specified, and some before and after. In dry weather, it is well to sow and plant immediately the soil is dug. Seeds cannot vegetate without moisture, yet it is not good to drench them with water, and then allow them to be parched up by the sun's rays. It is better to spread a mat over the bed to prevent the surface from drying till the seeds vegetate, when it must, of course, be taken off; but then the plants had better be shaded from the direct rays of the sun. Herbs for drying should be cut, in a dry day, before the flowers expand, and laid in a dry airy shaded place. Vegetables for pickling should also be gathered when they are quite dry.

American Cress.—Sow for winter use.

Angelica.—Sow as soon as the seeds are ripe.

Artichokes.—Cut down the stems when the crop from each is gathered.

Balm.—Gather for drying; it may now be propagated by slips.

Borecole.—Plant out.

Broccoli.—Plant out the late crop, and water frequently.

Cabbage.—If not done in the end of last month, the principal autumn sowing of Early Battersea, Vanaek, or Fulham, should be made in the first week, also some Early York; Red cabbage should likewise be sown at the same time. Plant out those sown for coleworts.

Cardoons.—Band a few of the earliest with hay or straw, and earth up for blanching.

Carrots.—In the beginning of the month, sow the Early Horn, for spring use, in a warm sheltered situation.

Cauliflowers.—Sow about the 20th in a situation where they can be protected during the winter. This sowing may be made a little earlier or later than the above period, according as the situation is cold or warm. Do not allow the crops to suffer from drought.

Celeriac.—Suckers should be closely removed from the top of the root.

Celery.—Earth up the early crops as they advance, taking care to keep the hearts of the plants free from soil. Apply lime for slugs, and attend to watering.

Chervil may be sown.

Chicory.—Thin to 3 or 4 inches apart.

Corn Salad.—Sow for winter supply.

Cress.—Continue to sow the Curled, and also the Normandy cress.

Endive.—Sow in the beginning of the month for a late crop. Plant out from previous sowings; and plants sufficiently advanced should be tied up to blanch.

Garlic.—Take up when the leaves become yellowish and begin to wither. Spread the bulbs to dry in the sun, but shelter them from rain. When well dried, string them by their withered leaves on a dry straw rope.

Lettuce.—Towards the end of the month, sow for winter and spring use the Brown Cos, Green Paris Cos, and Hammersmith Hardy Green Cabbage lettuce, or other hardy sorts. Tie up crops as they advance.

Mustard.—Continue to sow.

Onions.—Sow about the middle of the month, for standing the winter and for drawing young; and at the end of the month a small sowing for succession. Some Welsh

onions, being very hardy, may also be sown. Take up the main crop when ripe, and spread in the sun, on dry ground or gravel, till dry for housing.

Pease.—Those sown last month for the latest crops should be kept well mulched and watered.

Radishes.—Black and White Spanish, for autumn and winter use, may be sown; also some of the Early White Turnip-rooted.

Shallots.—Take up when the leaves begin to wither, and treat in the same way as garlic.

Spinach.—Sow the main winter crops, partly in the second, and partly in the last week of the month.

Tomatoes, placed against a wall or paling, should be kept nailed and stopped. Gather fruit when ripe.

Turnips.—Make a small sowing of the White Stone and Yellow Finland early in the month, for spring use.

II.—HARDY FRUIT DEPARTMENT.

The gathering of various fruits will require particular attention in this month. Early kinds of apples and pears, if gathered a few days too early, will be watery and insipid; and will not become sugary by lying in the fruit-room. If, on the other hand, they are allowed to remain a few days longer on the tree than they ought to do, they become mealy. Their precise period of maturity must therefore be watched. Apples and pears ripening at this time should not be gathered during the hot period of the day, otherwise they are apt to turn sour. Gooseberries, currants, raspberries, and strawberries, are best gathered when cool and dry; but peaches, nectarines, apricots, plums, and cherries, may be gathered when dry at any time of the day.

Protect Morello cherries on walls by netting; gooseberries and currants intended to be matted up should previously have the summer shoots pruned out. Peach and nectarine trees should have a number of dry bean-stalks introduced among the branches to trap earwigs. Go over these every morning and blow the insects out of the bean-stalks into a bottle half-filled with water; replace the stalks, and continue till the insects are reduced to few or none. Crevices between the soil and the bottom of the wall are highly favourable to insects, such as ants, wood-lice, &c. The soil close to the wall should be frequently stirred,

or part of it may be taken away so as to form a sort of shallow furrow. The portion of wall thus exposed should be scrubbed clean, and, instead of returning the old soil, it is advisable to replace it with fresh.

Continue to train the shoots of wall-trees, nailing them in as they require; and, as this is being done, remove nails with which the swelling fruit is likely to come in contact. The more any shoot is at liberty the stronger it will grow, and the more it will be encouraged to produce laterals; therefore, all shoots having a tendency to grow too strong should be kept closely nailed in; these will be the more upright leading shoots. On the contrary, weak shoots, on the lower part of the tree, should be left at more freedom, taking care, however, that they are inclined to the direction in which they must ultimately be nailed.

Some of the early stopped vigorous shoots of apples and pears will have pushed a fresh leader; this should be cut back to about 2 inches from its base. Finish budding, and slacken the tyings of buds as the swelling of the stocks renders necessary.

It is now a good time to make plantations of strawberries, if the season has been favourable for the production of runners. If the ground is not prepared, and if the runners are well rooted, they may be taken up and planted 6 inches apart in nursery beds. Shade, if necessary, till the plants get fresh hold; and water according to the state of the weather. Continue to cut off runners, when not required for new plantations. Thin the young shoots of raspberries, leaving from four to six of the strongest. After the crop is gathered from the bearing branches, they should be cut, so that the young shoots for bearing next summer may have all the light and nourishment.

III.—FORCING DEPARTMENT.

Mushrooms.—Prepare dung for beds; fresh ones may be made. Spawn those made up last month when they are in a fit state.

Cucumbers.—If the weather is dull and wet, the linings will require to be worked so as to maintain a proper heat. When the air is warm, but without bright sunshine at the time, the lights may occasionally be entirely taken off. In case of red spider, syringe frequently and strongly, provided it is done with a very fine rose. Sow about the middle of the month for winter bearing. Those out of doors

should be dusted with flowers of sulphur to prevent mildew. Gather for pickling; in general all should be gathered, from the oldest to the youngest, that are at all fit. By so doing, a better succession of young fruit will be insured than if a number of old fruit were allowed to grow.

Melons.—Keep up a steady bottom heat of 80°, and as much top heat, with plenty of air. Shade no more than is absolutely necessary. Do not encourage the foliage to become broad, unless it is at the same time proportionately thick in substance. Abundance of air night and day will render it robust. It is better to employ these means than to attempt checking luxuriance by limiting the supply of moisture at the root, for in that case red spider will be encouraged. The supply of water must, however, be gradually diminished as the fruit is ripening.

Pine Apples.—Shifting should generally be completed before the middle of this month. The bottom heat for succession plants and others should be from 85° to 90°. After shifting, the plants should be kept close, and more shaded than usual. Water at the root should be withheld till fresh roots commence to be emitted; but the foliage should be daily moistened by syringing, with a fine rose, towards six in the afternoon. Although dryness in the air of the house is to be avoided immediately after shifting, yet water should not be allowed to remain long in the axils of the leaves. A little additional heat and air will cause such to evaporate. Pot crowns and suckers as they can be taken off. Plants that have flowered should have fibrous soil placed round the edges of the pots, and packed close to the necks of the plants, to encourage fresh roots. Supply liquid manure to these occasionally.

Vines.—Dryness is essential to the keeping of ripe grapes in good condition, till required for use. Therefore, in dry clear weather, abundance of air should be given during the day, and a moderate quantity at night; but when the weather is wet, with little or no sunshine to dry up the damp, a little fire-heat, with a free circulation of air at the same time, will have a beneficial effect. When the surface of everything within the house is rendered warmer than the external air, evaporation will carry off all deposition of moisture. Vineries, in which the fruit is swelling, should be kept moist; and this will be difficult in such hot dry weather as frequently occurs in this month. The paths

must be kept flooded, the foliage syringed, and, in order that it may not be suddenly dried, the ventilation should be reduced. In such weather, the leaves of a healthy vine carry off an immense quantity of moisture by evaporation, and they cannot be long healthy if the loss by evaporation is not replaced. The red spider will soon afford evident proof of this. Remove superfluous shoots, and unhealthy and decaying berries. Frontignans, when ripe, are apt to shrivel when the bunches are exposed to hot sun, and therefore the front ought to be shaded.

Figs.—Plants, on which the fruit is swelling, will require a deal of water at this season. Once a-day will not be generally sufficient; the best rule is to give them regularly as much water as they will take up. The soil in the pots or border should never be dry, neither should it be constantly soaked as if aquatics were to be grown in it. Syringe the foliage, and the more frequently, if red spider make its appearance. When the fruit begins to ripen, gradually reduce the supply of water, and take care that no suckers are allowed to spring up from the root, for the sap will flow to them rather than to the fruiting branches.

Peaches and Nectarines.—When the crop is gathered, the border should be examined to see that it has not got too dry; and if it has, it should be moderately watered. The trees should be regularly syringed, and air freely admitted, in order to ripen the wood. If the weather is favourable, the lights may be entirely taken off.

Strawberries.—Shift into larger pots those that were layered for forcing.

IV.—FLOWER GARDEN AND PLEASURE-GROUNDS.

The lawns, walks, and borders should be kept in high order, as before directed. Clip hedges, and in so doing recollect that the narrower they are kept at top the less naked they will be at bottom. If they bound or intersect a place laid out in the geometrical style, it may be desirable to cut their sides perpendicularly, or so little narrower at top than at bottom as not to be perceptible; but there can be no necessity for having hedges in the smallest degree wider at top than at bottom. Cut in this manner they are decidedly unsightly, and the more care that is taken to trim neatly on this bad principle, the more unsightly do they appear. Clip box edgings, choosing

cloudy weather. Cut in laurels and other shrubs that are overgrowing adjoining plants. Cut out decaying stalks of herbaceous plants from amongst the fresh foliage at bottom, but the latter should not be shorn off at the same time, as is sometimes done. Various rock plants will require to be kept from overrunning their proper bounds, and thus, in a great measure, effacing all variety of plants and surface. Continue to tie up flower-stems that require support. Gather seeds of choice flowers as they ripen. Train creepers. Roses on walls should be nailed first at the top, if it be not desirable to have the lower part of the wall almost naked. Bud roses, and loosen the ties of those previously budded.

V.—PITS AND FRAMES.

The cuttings of any plants which it is desirable to propagate should be put in as soon as possible, in order that they may get well rooted before winter. Pot off such as are already sufficiently rooted. Prick out seedling plants. Sow choice annuals for flowering in the green-house, selecting such kinds as will give variety of colour, either among themselves, or along with the green-house plants that will be in flower when these auxiliaries are introduced.

Anagallis.—Propagate by cuttings.

Auriculas.—Repot, if not done in the beginning of summer; place the pots in a frame facing the north, and keep close for some days.

Calceolarias.—Put in cuttings, and sow seed as it ripens.

Camellias.—Propagate the Single Red by cuttings, for stocks.

Carnations.—Take up and pot layers when sufficiently rooted.

Cinerarias.—Propagate by cuttings. Use sulphur to prevent mildew. Sow seed.

Heart's-ease.—Sow in pans, and place in a cold frame. Cuttings may still be put in.

Mignonette.—Sow in pots for winter flowering. Place in a frame, but give abundance of air.

Pelargoniums.—When the first cut down plants have pushed sufficiently, take them out of the pots, and shake the old soil from the roots; shorten the straggling shoots, and repot in smaller pots. Keep close until the plants take fresh root, till which time water will scarcely be required, but the tops may be slightly dewed over occasionally with a fine rose. Propagate by cuttings; and seeds may be sown.

Petunias.—Propagate by cuttings, for next year.

Pinks.—Rooted pipings should be protected from too hot sun, but otherwise they should be freely exposed, night and day, preparatory to planting them out. Pot for forcing.

Roses.—Cuttings may be put in frames, or in a warm border under a shaded hand-glass.

Stocks.—Sow Ten-weeks, for winter flowering.

Verbenas.—Propagate by cuttings.

Violets.—Plant the Neapolitan on a prepared bed adapted for being covered with a frame in winter. Pot for forcing.

VI.—GREEN-HOUSE.

Shift plants that are growing vigorously, and have filled their pots with roots. In doing this, more care is requisite than when the plants are in a less active state of growth. Shade and keep the plants rather close till they take fresh root. Keep the pots clean from moss, and refresh the soil by top-dressings. Continue to prune, stop, and train, as before directed. Remove decayed leaves and flowers. Shade plants in flower, and likewise others when the sun is strong. Bud oranges and lemons. Take in succulent plants, if much wet prevail; and also camellias, if they have formed their flower-buds. Attend well to the watering of all plants in dry weather, and particularly to those growing in peat, such as epacris, &c. Manure water may be given to various plants after they have set for blooms.

VII.—PLANT STOVE.

The temperature should be maintained, so as to admit of more air to ripen the growth made in the course of the summer, but the house should be shut up early. Where it is desirable that plants should not make much growth late in the season, the water afforded them should be somewhat limited. Continue to stop irregular shoots. Attend frequently to the training of creepers, for by so doing the operation can be much more easily and better performed than when the shoots get much entangled. Bring in succulents from frames. Shift such plants as require it, and especially those for flowering in winter and spring. Orchids should have a temperature of 75° by night, and 80° to 90° by sun-heat. Close up early in the afternoon.

SEPTEMBER.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in Inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	57·11	3·83	21
Middlesex..	Chiswick...	51 29	0 18 W.	56·95	2·45	30
Gloucester.	Stroud	51 45	2 13 W.	57·15	2·79	30
Lincoln.....	Boston.....	52 43	0 5 W.	54·02	2·20	20
Dublin	Dublin	53 21	6 11 W.	56·48	...	17
Lancashire.	Liverpool..	53 25	2 59 W.	57·87	...	25
Dumfries ..	Applegarth	55 13	3 12 W.	52·21	2·52	19
Mid.-Loth.	Edinburgh	55 48	3 11 W.	55·00	2·23	20
Aberdeen..	Aberdeen ..	57 9	2 5 W.	56·72	...	8
Orkney... ..	Sandwick..	59 5	3 17 W.	52·26	2·75	26

I.—KITCHEN GARDEN DEPARTMENT.

In dry weather, the ground should be kept well hoed, so that not a vestige of weeds may be seen when wet sets in. There will then be less occasion to tread and puddle the ground in attempting to destroy weeds when the state of the weather is unfavourable for doing so.

Cabbage.—Plant out, from the principal autumn sowing, 2 feet apart each way, to remain for hearting; and plants may be inserted intermediately, for use as coleworts.

Cardoons.—Band, and earth up full-grown plants to blanch.

Cauliflowers.—Plant out the August sowing where they can be protected by hand-glasses, or other means. If the weather is mild, another small sowing may be made about the middle of the month on a warm border.

Celery.—Earth up for winter use, performing the operation when the soil is dry.

Chervil.—A small sowing may be made for winter supply.

Corn Salad.—Sow for winter and spring use.

Cress.—Sow in a warm situation.

Cucumbers.—Gather for pickling.

Endive.—Plant out successions of Green Curled and White-flowered Batavian, and tie up for blanching those sufficiently advanced.

Leeks.—Draw a little earth to the roots.

Lettuce.—Plant out successions in sheltered situations, and tie up plants as they become fit. Another sowing of the sorts recommended last month may be made in the beginning of this.

Mustard.—Keep up a succession.

Onions.—Take up any that may not have been fit last month. House those which are sufficiently dry.

Parsley.—Cut down, in order that young leaves may be formed before winter.

Pease.—Water the late crop, if the weather is dry.

Potatoes.—Take up and store.

Radishes.—A small sowing may be made for late supply.

Spinach.—Hoe and thin. If not already done, the winter crop should be sown early in the month.

Turnips.—Hoe and thin.

II.—HARDY FRUIT DEPARTMENT.

In this month the protection of ripening fruit, and the gathering of it when it is fit, require the most urgent attention. Peaches and nectarines attract thousands of enemies, consisting of wasps, earwigs, flies, and ants; and in moist weather snails even will set upon the nectarines. The various insects attack in preference the best and fairest fruits. The greatest connoisseur could not better select the finest flavoured. Therefore, every available means should be taken to prevent the depredations which would otherwise be made. Earwigs must be trapped in bean-stalks, as previously directed, and wasps enticed by some sweet beverage into bottles. Wood-lice and ants will be inclined to emigrate if their haunts and hiding-places are daily broken in upon by the hoe and rake; of the latter implement it can also be affirmed, that where it has been recently plied along the bottom of the wall, and on the border, certain bipeds do not like to tread.

The leaves that shade peaches and nectarines should be turned aside, that the fruit may be exposed to the direct rays of the sun. Over some of these fruits which it is most important to preserve, Halliman's fruit protectors may be placed. When the fruit of a peach or nectarine tree is all gathered, the succession shoots should be looked to, and, if any of them are crowded, the shoots that have borne fruit should be cut back close to the base of the succession shoot. This being done, let the trees be frequently syringed. The shoots of pear trees on walls will have pushed again; let these secondary growths be cut back to within 2 inches of their origin. Prepare ground for strawberry plantations, and plant in dull weather; or the runners may be planted 6 inches apart in nursery beds.

III.—FORCING DEPARTMENT.

Kidney Beans.—Sow in pots or boxes, for use in November. Let the pots be only half-filled with soil to allow of earthing up the young stems.

Mushrooms.—In this month the spawn naturally vegetates more freely than in any other, and it is found to be the most proper time for making beds for a supply from November till spring. Spawn may be introduced when the heat of the bed is 70°, and a little air should be given. When the heat of the beds declines some time after spawning, cover them over with a layer of straw; but care must be taken that this do not cause them to become too hot. If this is likely to be the case, the covering must be made lighter. Between 55° and 60° is a good temperature for beds in bearing.

Cucumbers.—Plant in pits, or rear in boxes, the plants raised from seeds sown last month for winter bearing. Sow again at the end of the month. Keep up the heat to those that are in bearing.

Melons.—In this month the temperature naturally declines to a considerable extent; but fruit, as it approaches maturity, should have an increased rather than a diminished temperature; therefore, more artificial heat must be given for this purpose; the linings must be turned, and if necessary more fermenting materials should be added. When the heat is well kept up, more air can be given than would otherwise be the case, and, consequently, the fruit will be better flavoured. Attend frequently to stopping laterals, so that there may be few to cut out at any one time. Little water should be given, but in fine weather the foliage may be refreshed by sprinkling it in the mornings with a fine rose.

Pine Apples.—Shift all that require more space for their roots. Continue to plant suckers and crowns immediately the moisture is dried at the ends. When planted or potted, water will not be required till they begin to push roots; and till these are formed, the leaves should not be exposed to sun, nor to the drying effects of a circulation of air, but, on the contrary, they should be kept shaded, and in a warm moist atmosphere. When rooted, air should be more freely admitted, in order that the plants may not grow too slender, and they should then be placed near the light. Fruits that are swelling

should have a high and rather moist temperature, with a bottom heat of 84°; the top heat for these may be 75° at night, and from 80° to 90° by day. If the tan has been taken away from the sides of the pots on account of too great heat, let it be replaced as soon as it falls to 84°. Gradually reduce the supply of moisture as the fruit approaches maturity. Give manure water to succession plants, and more of it in clear weather than in dull, for in the latter they could not so well digest it. Syringe with water of the temperature of 80°. A little air should be given in the morning, but the house should be shut up early in the afternoon.

Vines.—The wood in the earliest vinery ought now to be thoroughly matured. The house should be thrown open night and day, in order to keep the temperature low. Vegetation being thus rendered inactive, the vines should be pruned. In doing this, according to the spur method, any of them that are too long, should be cut nearly close to the branch from which they proceed. In vineries where the grapes have only just been gathered, and the foliage not yet decayed, attention must be paid to the ripening of the wood, by admitting plenty of air and sun; and a little fire-heat will be necessary when the weather is dull, air being given at the same time. When the fruit is commencing to colour in the latest house, plenty of air must be given during the day, and a moderate quantity at night. This free circulation of air will require fire-heat at night, and occasionally a little through the day. Remove superfluous shoots and laterals, and syringe the foliage, so as to keep it always clean and healthy. Vines in pots may now be started.

Figs.—Attend to former directions as regards a regular and plentiful supply of water, and if the plants are not over-vigorous, manure water may be given to those on which the fruit is swelling. As the fruit ripens, the supply of water must be limited; but still, in this case, the quantity, though less, must be judiciously administered, and so that at no period the tissue of the plants get too much dried up.

Peaches and Nectarines.—When the leaves begin to lose their hold, take a fine-twigged broom, and draw it lightly in a direction from the base to the extremities of the shoots, so as not to injure the buds. Repeat this operation at intervals, till the whole are removed.

Let all the leaves be picked up from the floor of the house after each brooming. Expose the trees to sun and air. The house should be cleaned, and painted if necessary, and likewise the sashes.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

Continue to hoe and rake borders, and to weed and roll walks. Sweep, roll, and mow lawns; and where worm-casts abound on these, they should be raked over with an iron rake, having short, curved, and thickly-set teeth. After wet, it would be well to roll the margins of walks. This will press them a little beyond their proper limits; then stretch the line, and with the edging-iron cut the edging afresh, so as to give the walk its proper breadth. Turf may now be laid; and if the weather is dull, and the nights mild and dewy, as is generally the case in this month, the grass will soon take fresh root, and will become well established before winter; as will likewise box, and other edgings, if now laid. Dig, trench, or otherwise prepare ground for bulbous roots, various kinds of which, taken up after blooming, may be planted, such as lilies, narcissus, some of the smaller bulbs of tulips, but not the principal ones, snowdrops, hyacinths, crocuses, anemones, and ranunculuses.

Plant perennials that have been cut back after flowering; also pinks, carnations, polyanthus, and seedling heart's-ease. Remove and plant evergreens towards the end of the month. Fill up vacancies with reserve flowering plants, so as to maintain a varied display of colour in the beds and borders. Propagate, if required, evergreens, by cuttings and layers. Sow mignonette, ten-week stocks, and various annuals, to flower early next summer. Continue to remove decaying stalks of all herbaceous plants after flowering. Prune and nail creepers. Tie up dahlias, and other plants; also shade the flowers of such as require it. Gather seeds of all choice plants as they ripen.

V.—PITS AND FRAMES.

Continue to pot off cuttings as they become sufficiently rooted. These, and plants that are shifted, should be kept in a close frame, shaded from strong sun, till they strike fresh root. Water when the plants require it, but rather in the mornings than at night. Bulbs that have nearly completed their growth

should have the supply of water gradually diminished. Air should be freely given, to render the growth of plants more firm, so that they may the better stand the winter. Pinch off the tops of any shoots that are growing too long and straggling. Thin annuals sown in pots. Propagate half-hardy plants by cuttings. Pot bulbs in sandy peat and loam, for forcing. Sow annuals, such as rhodanthe, schizanthus, collinsia, ten-week stocks, &c.

Calceolarias.—Repot seedlings; keep clear from green fly.

Carnations.—In the end of the month, pot those that are to be wintered in frames, and place the plants near the glass, but shade from too strong sun. When layers are taken off from the stools, the latter may be potted for forcing.

Chrysanthemums.—Water with liquid manure. Thin the buds where particularly fine specimens of flowers are desired.

Fuchsias.—The plants in flower should be kept rather cool, and have but little water.

Mignonette.—Sow in pots for succession. When the plants come up, thin them properly before the roots or tops affect each other. Attend carefully to give moderate watering.

Pelargoniums.—Those standing out of doors should be taken in, sooner or later, according as the state of the weather may render necessary. The earlier in the month the better, if it is wet and cold.

Pinks.—Some of these may be potted, to be preserved in frames for flowering in pots, or for planting out where vacancies may occur.

Roses (in pots).—Prune for forcing. Those required to bloom the earliest should not be much shortened, as the buds near the base of the shoots do not push so quickly as those near the extremities. Propagate China roses by cuttings.

Verbenas.—Pot off singly, into small pots, as the cuttings become rooted.

VI.—GREEN-HOUSE.

Preparations must now be made for bringing into the green-house the plants that were turned out. Complete, in the first place, all necessary repairs in the house. If heated by a flue, this should be examined and cleaned, if requisite; but, at all events, straw should be burned in the furnace, so as to produce a large volume of smoke, for the purpose of as-

certaining whether there may be any cracks in the flue, by which gases could escape. Any large specimens left in the house should be taken through hand, and thoroughly cleaned, as this can be done more readily before the other plants are introduced. According to the state of the weather, the plants must be taken in earlier or later in the month. Commence by bringing in the more tender sorts; and succulents ought not to be left exposed to continued damp or soaking rains. But, before any plants are taken in, see that they are in a good healthy condition, and that their drainage is perfect; if in any case it is not, then repot. Let the surface of the soil in all the pots be taken off, and replaced with fresh. The pots should be washed clean, and no moss should be allowed to appear. Plants in pots, on damp soil, will draw moisture from the latter, but, when deprived of this moisture by being placed on a dry stage, they are apt to suffer, if not well attended to with water. Give abundance of air to ripen the wood. Most things will now bear the sun's rays, so that little shading will be required.

VII.—PLANT STOVE.

The best time for encouraging the growth of stove exotics, is when the least artificial means are required, when the heat of summer renders fires almost unnecessary, and when the amount of light is greatest. That season is

nearly over; and it now becomes necessary to prepare for the approach of winter, by endeavouring to give firmness to the growths already made, rather than to encourage further luxuriance. Plenty of air must therefore be given; the plants must be kept drier both at root and top; water should be given in the mornings, so that it may evaporate before the house is shut up. Fire-heat, more or less, may have to be applied at night, but the temperature should then be lower than in the previous months, when moisture was not necessarily withheld. Although dryness is recommended, it must not be carried too far; in other words, it must be understood, relatively, as a state of much less moisture than that maintained in former months, and it should be gradually brought on. If, in consequence of this drier condition, red spider, or other insects, make their appearance, the house must be occasionally shut up moist.

Various plants may be removed to hot pits, to make room for others that will now have to be returned to the stove from the greenhouse, on the latter being filled with its proper inmates. Let these have their foliage and pots well cleaned before they are taken to their fresh quarters. By maintaining the heat in the orchid-house throughout the day, and allowing a tolerably free circulation of air, the pseudo-bulbs will become firm and less apt to shrivel. The temperature at night should now be lowered to 70°.

OCTOBER.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	53° 36	3·60	21
Middlesex..	Chiswick ...	51 29	0 18 W.	50° 00	2·80	30
Gloucester.	Stroud	51 45	2 13 W.	49° 60	2·91	30
Lincoln.....	Boston	52 48	0 5 W.	49° 25	2·44	20
Dublin.....	Dublin	53 21	6 11 W.	50° 08	...	17
Lancashire.	Liverpool..	53 25	2 59 W.	51° 64	...	25
Dumfries...	Applegarth	55 13	3 12 W.	46° 35	3·66	19
Mid-Loth..	Edinburgh	55 48	3 11 W.	49° 00	2·40	20
Aberdeen .	Aberdeen ..	57 9	2 5 W.	49° 47	...	8
Orkney.....	Sandwick..	59 5	3 17 W.	47° 64	4·99	26

I.—KITCHEN GARDEN DEPARTMENT.

Prepare vacant ground for future crops. Remove all fallen and decaying leaves; and continue to hoe, weed, and stir the ground occupied by crops. Dress the herb borders. Draw earth to the stems of the cabbage tribe.

Cabbage.—Finish planting out for spring use and for coleworts.

Cardoons.—Continue to band and earth up for blanching.

Carrots.—Take up part of the crop and store in sand. Clean and thin young crops sown for use early in spring.

Cauliflowers.—Prick out where the plants can be protected in winter, either by frames, hand-glasses, or hoops and mats.

Celery.—Continue to earth up. Prepare thatched hurdles, or other materials, for protecting the plants from frost.

Chives.—Plant divisions of the roots in patches 9 inches apart.

Endive.—Continue to blanch as it is required for use. The Curled may be blanched by laying tiles over it.

Garlic.—Towards the end of the month plant the cloves, 6 inches apart, in shallow

drills 1 foot asunder. Reserve part for another plantation in the spring; if the soil is damp the whole had better be deferred till that season.

Lettuce.—Plant out on warm borders from autumn sowings.

Nasturtiums.—Gather for pickling.

Onions.—In wet days look over those stored up, and remove any that may be spoiled.

Potatoes.—Take up and store in narrow ridges. Expose the tubers to light as short time as possible. Those intended for sets may, on the contrary, be greened in the sun.

Shallots.—See *Garlic*.

Tomatoes.—Gather fruit and hang up in a warm place, or lay them on a hurdle, or on wicker-work, in a frame or vinery.

II.—HARDY FRUIT DEPARTMENT.

Most kinds of apples and pears will be fit for gathering in the course of this month. As a general rule, they should be taken when the fruit readily parts from the spur on being lifted with the hand to a horizontal position. In that case the stalk does not break, but separates at its junction with the spur. But if it does not thus separate, and requires pulling or twisting to break, the fruit is, with some exceptions, not fit for gathering. Care should be taken not to bruise the fruit; it is covered with a sort of bloom or waxy matter which ought not to be rubbed off. Some, very properly, do not even touch very choice pears, but gather them by taking hold of the stalks. The late-keeping sorts should be stored in a compartment, where the exhalations from the early ripening kinds will not reach them. Admit air chiefly when the external temperature is equal to that inside the room, or nearly so. The surface of the fruit becomes wet when air of much higher temperature is brought in contact with it, the moisture of the air being condensed by the relatively colder fruit.

Some kinds of plums, such as Coe's Golden Drop, and Ickworth Impératrice, may be laid in a dry place for a week, and then wrapped in tissue paper and placed in shallow boxes, in a dry room, till required for use in winter.

Gather filberts, medlars, quinces, and walnuts. Dry filberts on hurdles, for packing in jars, with their husks.

Protect the fruit of late peaches on walls from cold at night. When the leaves of peach and nectarine trees begin to fall, take a fine-twigged birch broom and lightly touch

the leaves, moving the broom from the base of the branches towards their extremities. The leaves that are thus very easily removed are of no use as regards the vegetation of the tree; and by dispensing with them, more sun and air will be admitted for the better maturing the wood of the young shoots.

Collect soil for fruit-tree borders that require to be renewed, or for partial renewal, where trees require to be replaced. Planting may be commenced as soon as the leaves have dropped, but not before, otherwise they evaporate more moisture than the roots are prepared to supply, and consequently the shoots become shrivelled.

Propagate gooseberries and currants by cuttings, taking care to pick out the eyes from the lower part of the cutting, and as high up as 3 inches above the depth to which it will be inserted in the soil. Make fresh plantations of raspberries and strawberries.

III.—FORCING DEPARTMENT.

Chicory.—Take up and plant in pots or boxes for forcing.

Endive.—Plant under hand-glasses, or in frames.

Kidney Beans.—Earth up and place near the glass. Give water as they require it, which will be more frequently as the plants advance in growth.

Lettuce.—Transplant under hand-glasses, on a prepared slope facing the south, or in frames, some of the Brown Cos, Green Paris Cos, Hardy Hammersmith, and Neapolitan Cabbage lettuces. Prepare a sloping bed, about 1 foot thick, of decayed materials and litter, not for heat, but to act as drainage. Over this, place a frame and fill it to within 6 inches of the top with light rich soil. Sow in this, for planting out in the open ground early in spring, the White Paris Cos, a little of the Green Paris Cos, and the Neapolitan Cabbage lettuce. Keep the sashes close and shaded till the seeds germinate, then give plenty of air. An old hot-bed, with the frame filled up with soil, will answer very well for raising and keeping lettuce plants during the winter.

Mushrooms.—Maintain a moist atmosphere by sprinkling the paths, and other surfaces, within the house; but water must not be applied directly to the beds. Where fire-heat is at command, or if the house is heated with pipes, a dense steam can easily be raised. The

temperature of the air of the house should be about 60°. Admit a little fresh air for a short time every day.

Cucumbers.—Sow for winter produce, or propagate by cuttings. If sown on the first of the month, the plants will be fit to transplant into the fruiting pit about the end of the month. It is highly essential that the young plants should be kept as near the glass as possible, without touching it. Without plenty of light they cannot make good roots.

Melons may yet be fruited; but the sun's rays, by which their flavour is chiefly influenced, have now much declined. Keep the plants warm and dry, giving as much air as the state of the weather will permit.

Pine Apples.—If the bottom heat is likely to decline below 84°, preparations to renew the bed must be made where tan and dung are used. In doing this, a portion of the old tan should be well mixed with the new, and some of the oldest will have to be dispensed with. It is, however, of essential importance that the plants should be raised as near the glass as possible; and therefore the quantity removed must be regulated accordingly. If leaves are the heating material, some hot tan should be worked in near the pots till the leaves can be collected.

The fruiting plants should be put into a house by themselves, or if such accommodation cannot be afforded, they should be placed at the warmest end of the house. These plants should have manure water occasionally till the fruit is swelled; but when this is the case, all watering should be withheld, and it is desirable, on account of flavour, that they should be kept in a dry, hot, yet ventilated atmosphere, of 70° at night, but with sun-heat as high as 85° or 90° in the day. The temperature for succession plants should be gradually lowered in the course of the month to 60° at night, and should not exceed 70° by day. This temperature will not much excite their vegetation, and they will afterwards succeed better than if completely checked in their growth by the very low temperature to which they are sometimes artificially subjected.

Vines.—The latest vinery should have a temperature of 60° at night, and 70° by day, or 80° by sun-heat. Give plenty of air to carry off exhalations, which would otherwise prove injurious, more especially at this season of the year.

Presuming that the shoots in the earliest house are perfectly matured, the vines should

be pruned and all the rough loose bark stripped off. The house should be thoroughly cleaned—the rafters, sashes, and all wood-work—with soft soap, taking care, however, that the latter be washed off the glass. The vines should then be washed with warm soap-suds, and afterwards anointed with a mixture of soft soap and sulphur. The walls should be white-washed with lime and sulphur; the flues may be brushed over with cement water quickly applied. This being done earlier or later in the month, according as the demand may be for very early grapes, the sashes should be put on and a moist atmosphere maintained. A higher temperature will be required to start the vines at this season than in January or February. Cover the border with a good thickness of materials that will prevent the escape of heat, such as leaves, fern, straw, or long litter. There should be a good thickness laid on, and in a manner that will throw off the cold winter rains.

Figs.—A temperature of 60° to 65° will be required to ripen off the late crop; and 10° higher by sun-heat may be allowed with plenty of air. As the external temperature declines, a little more fire-heat should be given. Keep the floor and air of the house dry. Water only at the root, and that very sparingly.

Peaches and Nectarines.—If the shoots still continue to vegetate, fire-heat must be given, with abundance of air, and the house should be kept dry. When all the leaves are completely cleared off, the trees may be pruned.

IV.—FLOWER GARDEN AND PLEASURE-GROUNDS.

With cold nights and a general decline of temperature, the green colour of the leaves of many trees gives place to varied tints of yellow, brown, red, and purple; but rich as these hues appear, the gardener must look upon them as the forerunners of stormy blasts, with cold and heavy rain, or otherwise of frosty nights. He must therefore be in readiness to take up such plants as would suffer from inclement weather, such as pelargoniums, fuchsias, salvias, dahlias, &c.

The lawns should be kept well rolled and closely mown, for if this is not done before winter, they can neither be so easily nor so smoothly cut in spring; besides, as it will now be frequently necessary to remove fallen leaves, the latter can be much more easily swept up when the grass is smooth and cut short, than when it is otherwise. The walks should be

kept well rolled, and their edgings neatly cut. When walks, edgings, and lawns are in high keeping, the garden, though not now so gay with flowers as in summer, will, nevertheless, have a pleasing effect, from contrast with the wreck of vegetation elsewhere.

Plant bulbs, such as crocus, narcissus, tulips, hyacinths, and snowdrops. A portion of ranunculuses and anemones may be planted now, reserving some for planting in spring in case of accident. When Tiger lilies have done growing, they may be taken up, parted, and replanted. Plant heart's-ease, wallflowers, stocks, sweet-williams, and other biennial and perennial flowering plants, raised in the course of the season from seeds or cuttings. Seeds of hardy annuals may be sown where they are intended to flower. Evergreens may be planted any time this month; and all deciduous trees and shrubs immediately after their leaves have fallen.

V.—PITS AND FRAMES.

Additional artificial heat will now be required for the warmest division of these, in which cuttings are being struck, or where bulbs and various other plants are to be introduced for forcing, in order that a supply of flowers may be kept up during the winter. This may be kept at a temperature of 75°. Another pit heated only to 55° or 60° will be very useful for bringing forward many things that would otherwise not succeed so well, if at once introduced to the higher temperature, to which they may afterwards be properly subjected. This is a safe arrangement for all hardy or half-hardy plants intended to be forced.

Give plenty of air to rooted cuttings, and to bedding-out plants. Remove all dead leaves, and keep the glass clean.

Auriculas.—Those standing out should now be taken into a frame, with a southern aspect. Give plenty of air, and water sparingly.

Calceolarias.—Repot in rich soil, mixed with silver sand.

Carnations.—Expose to free air as much as possible; for any protection not required is absolutely injurious. Dust with sulphur to prevent mildew.

Heart's-ease.—Pot a considerable portion, in case those in the open ground should be injured in winter.

Hollyhocks.—Choice sorts may be propaga-

ted by cuttings at any time when these can be obtained.

Hyacinths.—Pot, and introduce to gentle heat. Those potted some time back will bear forcing in greater heat.

Lily of the Valley.—Pot for forcing; introduce to slight heat, and keep shaded till fresh roots are formed.

Lobelias.—Divide, and pot in small pots.

Mignonette.—Introduce to gentle heat for flowering. Prepare to shelter the stock in case of early frosts.

Polyanthus.—See *Auriculas*.

Roses.—Those in pots for forcing may now be shifted and pruned. The compost used should consist of fresh loam, enriched with rotten dung. Be sparing of water till growth commences. If some are introduced to gentle heat, they will probably be in flower about Christmas.

Verbenas.—Keep the young stock near the glass, giving plenty of air. Be now careful in watering, especially if any of the pots are not well filled with roots to act as drainage.

VI.—GREEN-HOUSE.

The more hardy kinds of green-house plants that may have been left out, or having temporary shelter afforded, should be taken in before frosty nights occur, or greater cold generally prevail than is usual in their native countries. Plants introduced in a flowering state from pits to the green-house, and now getting out of flower, must therefore be removed to make room for those above referred to. In arranging these, endeavour to keep the hard and soft-wooded kinds as much apart as possible; the placing of broad-leaved plants of an herbaceous nature in proximity to narrow-leaved, hard-wooded plants has not a pleasing effect, and it is injurious, for the hard-wooded suffer from the shade and exhalations of the other kinds.

Heaths, and other plants liable to suffer from damp, should be placed where the air in fine weather can freely circulate amongst them. Remove all dead leaves, decayed flowers, and everything that would cause mouldiness. Give air day and night when the weather is favourable. A little fire-heat, with air at top at the same time, may be necessary to expel damp. Water sparingly, as a general rule, but with discrimination, as regards the greater or less activity of growth in

the vigorous growing subjects. Chrysanthemums, and other plants advancing to flower, will require a liberal supply of water, and occasionally manure water should be given.

Pelargoniums for flowering in May should now be finally shifted, and likewise such of the young stock as have filled the pots with roots. They must be watered very sparingly, but care should be taken that they do not suffer for want of the small quantity they absolutely do require.

VII.—PLANT STOVE.

The mean temperature may now be 70° at night, and air should be given when the thermometer reaches 80° by sun-heat. Syringe occasionally to clean the foliage; but, generally speaking, the house should be kept

rather dry. Water should therefore be given chiefly in fine days, and in the forenoon, in order that with a little air the damp may be sufficiently dried up before the ventilators are closed, which should be early in the afternoon. Gesneras, Sinningias, Gloxinias, &c., should be kept dry. Place small plants near the light. Endeavour to keep all plants clear of insects. Creepers that lose their leaves should be cleaned and pruned.

Orchids should have a night temperature of from 65° to 70°, and 80° by day; the Mexican kinds, 60° by night, and 70° by day. Shut up at two P.M., or soon after, according to the state of the weather. Any kinds that are beginning to grow, should be placed in the warmest part of the house, and near the light.

NOVEMBER.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Yearly Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	47·54	5·47	21
Middlesex...	Chiswick...	51 29	0 18 W.	42·93	2·31	30
Gloucester.	Stroud.....	51 45	2 13 W.	41·50	3·29	30
Lincoln.....	Boston.....	52 48	0 5 W.	42·34	2·01	20
Dublin.....	Dublin.....	53 21	6 11 W.	43·69	...	17
Lancashire.	Liverpool...	53 25	2 59 W.	45·05	...	25
Dumfries...	Applegarth...	55 13	3 12 W.	40·83	3·05	19
Mid-Loth...	Edinburgh.	55 48	3 11 W.	43·00	2·75	20
Aberdeen...	Aberdeen...	57 9	2 5 W.	43·18	...	8
Orkney.....	Sandwick...	59 5	3 17 W.	42·59	4·38	26

I.—KITCHEN GARDEN DEPARTMENT.

It is now advisable to plan for next year's crops, so that as ground becomes cleared it may be properly treated for the kind of crop with which it is to be next planted or sown. Most crops ought to have manure, and some a great deal more than others. Trenching is generally advantageous, and stiff soils particularly should be ridge-trenched. Collect leaves and other refuse for manure, and other purposes. Prepare protection for such things as endive, lettuces, and celery.

Artichokes.—Towards the end of the month, or before frost sets in, cut off the long leaves to within 1 foot of the ground. Dig the latter, but so as not to cut the roots. Mulch with litter, fern, or leaves, to protect from frost, packing the protecting materials close to the plants all round, but not over their hearts.

Asparagus.—Cut down the stems, and clean the beds from weeds.

Beans.—Towards the end of the month a small sowing of the Early Mazagan, or Marshall's Dwarf Prolific, may be made. Sow in a warm border, in rows 2 feet apart.

Cabbage.—Hoe and clean between the rows; or loosen the soil with small three-pronged drags. Remove all decaying leaves.

Cardoons.—Continue to earth up and protect.

Cauliflowers.—Those that have formed nearly full-sized heads, should have a leaf or two broken, so as to bend over to protect from slight frosts.

Celery.—Continue to earth up, and protect from early frosts, which are frequently succeeded by heavy rains, causing the plants to rot, if previously allowed to be injured by frost.

Endive.—Continue to tie up for blanching. Remove some from borders, and plant on a dry slope. Protect from frost.

Garlic.—Plant, as directed for the end of last month, if not then done.

Horse Radish may be planted.

Pease.—Sow the Early Frame and Early Charlton on a south border, or other warm sheltered situation. These two, if sown at the same time, will form a succession. Set traps for mice, or adopt any other available means to prevent their attacking the pease.

Potatoes may be planted; the sets should be placed 7 or 8 inches deep in case of severe frost.

Sea Kale.—Remove decayed leaves. Put

some earth over the crowns, and cover with litter, preparatory to placing pots over the plants.

Shallots.—See *Garlic*.

II.—HARDY FRUIT DEPARTMENT.

The hardy fruit trees generally cultivated are deciduous, and all such trees are best planted when the leaves have fallen; for these evaporate more or less in proportion to the nature and extent of their surface, the heat of the weather, and dryness of the air. The weather at this time is generally cool and moist; yet in dry and sunny intervals the leaves must evaporate, and whilst they have any living connection with the tree, they will drain more moisture from it than the removed, partially mutilated, and unestablished roots can supply—even some of the juices which maintained the plumpness of the shoots is abstracted, and the bark shrivels. This is not the case, under the same circumstances of weather, when the tree is planted without leaves. But as soon as the leaves have fallen, planting should be immediately performed, or, if only a few leaves remain, they may be cut or pinched off.

In favourable soils and situations, most fruit-trees may be planted sooner or later in the month, as they become in fit condition, as above explained. In some cases where the trees have made late growths, that retain green foliage after the earlier formed leaves are quite mature, those late productions may be pruned off; for this, in all probability, would have to be done at last, owing to their being recently formed and too immature to be retained in a transplanted tree.

Prepare holes for the reception of the trees, and let them be as wide at bottom as at top, and rather deeper at the sides than in the middle—that is to say, the bottom of the hole should be convex instead of concave, as is too frequently the case. In taking up trees, endeavour to preserve the roots as much as possible. If the tree is large, let a wide and deep opening be made, so that it may be undermined with greater freedom. When taken up, let all bruised rootlets be cut clean off with a sharp knife. Plant as soon as possible after taking up, and as deep as the trees were in the ground before removal. Spread out the fibres, and introduce the soil carefully among them. Do not allow it to be thrown

against them, so as to reverse the position they ought to occupy. Water, in order to wash the soil into the cavities among the roots. Standard trees should be staked when planted; and if all newly-planted trees can be mulched before winter, so much the better.

This is the best time for removing and re-planting pear, apple, plum, and cherry trees, with the view of bringing them soon into a bearing state. In good soil, where these are apt to grow too much to wood, this is a very beneficial proceeding; and in bad subsoils it affords an opportunity of placing the roots inclining to penetrate such in a more horizontal direction in the better top soil. In planting wall-trees, let the stems be 6 or 8 inches from the wall, otherwise in growing they would press against it. If the soil, from heavy rains, is in bad condition for planting, it may be expedient to defer the operation till next month; or if circumstances should then be unfavourable, it is better to embrace the earliest opportunity in spring.

Soon after the fall of the leaf, pruning may be commenced as regards the apricot, peach, nectarine, vine, plum, cherry, pear, and apple. Also, gooseberries, currants, and raspberries, if not pruned last month. After wall-trees are pruned, the wall should be washed, and the trees likewise, taking care, however, that the buds are not injured in any way by the operation. Remove all decayed leaves of wall-trees from the borders, and bury them as manure in other parts of the garden that are being trenched. When the trees are pruned, and all cleaned up at the bottom of the wall, nailing may be proceeded with. Unnail fig trees, and tie them in bundles, ready for being protected by spruce branches, fern, or straw, on the appearance of frost.

Attend to airing the fruit-room, and remove from it all fruit exhibiting the least symptom of decay.

III.—FORCING DEPARTMENT.

Asparagus.—This may be forced in two ways: the plants may either be taken up and planted on a hot-bed prepared for the purpose; or, without removal, a frame may be placed over the plants, and heating materials applied to force them in the beds, in the open ground, where they have grown. The first produces smaller shoots, but they may be had in greater number from under the same extent of glass.

The plants must be taken up carefully, with all the roots possible, and planted closely together on the bed amongst light rich earth or vegetable mould. The temperature should be between 60° and 70° both for top and bottom heat. The lights should be kept close till the asparagus begins to appear, and then a little air should be admitted, to give the natural green colour to the tops. In the other mode, the frames should be placed on the beds, and a covering of light rich soil or vegetable mould put over the crowns; then the frame is filled up with soil, if light enough, from the trenches; the latter are filled with hot dung to the top of the frames. The sashes are then put on, and kept close.

Cauliflowers.—Those in frames should be kept hardy by exposure at all times, except in frosty nights or during heavy rains.

Chicory.—Introduce some of that in pots or boxes to gentle heat, in a dark place, to grow and blanch.

Endive.—Take up plants from the open ground, and plant in dry light soil in frames for blanching. A turf pit filled with good light soil, laid sloping, may be planted with endive, which could be protected with thatched hurdles in severe weather.

Kidney Beans.—Sow in succession. When the plants come up, remove them as near the light as possible. Fill up the pots as the plants advance.

Lettuce.—Prepare a slight hot-bed, which should have a temperature of about 55°. Cover it with vegetable mould or rich light soil. Plant with Cabbage lettuces. Be careful not to water after planting till the plants have made fresh roots; and at all times give no more than is absolutely necessary. Remove decaying leaves from these and other lettuce plants. Transplant Cos lettuces, under bell-glasses, in frames where a very slight bottom heat remains. Sow in frames some of the Hardy Hammersmith and Neapolitan Cabbage lettuce.

Mint.—Plant some roots in pots or boxes; the former are the most convenient for moving into any spare corner of a warm place.

Mushrooms.—Prepare beds for succession; cover with loamy soil a portion of those formerly made up. The layer should be about 3 inches thick, and firmly pressed. Attend to sprinkling the floor, and to maintaining a proper degree of moisture in the atmosphere.

Mustard and Cress.—Sow in succession.

Radishes.—Sow in frames, or in the open air, in a bed hooped over, ready to support a covering in case of frost or other inclement weather.

Rhubarb.—Roots may now be taken up and forced in any warm place that may be found convenient, whether in frames, mushroom-houses, or near a flue in a vinery.

Sea Kale.—Take up old roots, or, in preference, two or three year old plants raised on purpose, and plant in light soil in large deep pots; give no water when planted, otherwise the roots would be liable to rot. Place in a warm frame, mushroom-house, or elsewhere, in a heat of about 60°.

Cucumbers.—Those sown in the end of September will now require to be planted in the frames where they are to bear. Keep the glass of the sashes clean, so as to admit as much light as possible. Maintain a bottom heat of 75°, and the top heat about the same; but this may rise to 80° with sun-heat, air being admitted at the same time. Water in the early part of the day, taking care that the temperature of the water is about 75°, or nearly that of the air in the frames.

Pine Apples.—A low temperature is recommended for pines during the winter months when light is deficient, and in a relative sense this is very proper. But serious errors have been committed in estimating what is really a low temperature for the pine apple. Assuming that it will grow and ripen at a temperature of 80°, and that wheat will also grow and ripen at 60°, would not the constitution of the latter be injured by a mean temperature of 25° lower, or down to 35°? And if 25° below a fair growing temperature be injurious to wheat, must it not be supposed that 25° lower than the growing temperature of the pine apple, or down to 55°, will be injurious to its constitution, although from the strong fibre of its leaves they may not so immediately show the bad effects of such treatment as wheat would do? The roots must be kept in activity, otherwise they will decay. Maintain, therefore, a bottom heat of 75° to 80°, and a top heat of 65° to 70°. If the weather is sunless and cold, so that air cannot be given, the temperature in that case must be somewhat lowered, in order that the plants may not be drawn up. Fruiting plants will require a higher temperature, say 75°; and having more heat, take care that they have just sufficient moisture at root. The air of the house should also be kept tolerably moist

whilst the fruit is swelling, by sprinkling and gentle steaming.

Vines.—The mean temperature of this month is, on the average, little above 40° ; and the air is generally saturated with moisture. When this is the case, moisture will be deposited on all substances exposed to the air, if they are not warmer than it is. Grapes that are ripe should therefore be kept warmer than the air, otherwise they will be liable to damp. The application of fire-heat would effect this; but if it were applied suddenly, and without air being given at the same time, the heated air would deposit moisture upon the berries; for although these would ultimately acquire the same temperature as that of the air surrounding them, yet for a time they would be colder, and so long as this is the case, they would act as condensers of the moisture in the warmer air in contact with them. The more rapidly the air is heated, the greater for a time will be the difference between the temperature of the fruit and that of the air, and, of course, the slower the heating, the less at any time will be the difference. Give, therefore, in damp weather a little fire-heat in the morning, and admit air. If the nights are cold, the temperature of the house should not be allowed to fall lower than 45° . The house in which forcing is to be commenced for the earliest crop, or to have fruit ripe in April, should be shut up in the beginning of the month. As a higher temperature will be required to start vegetation in the vines at this season than in spring, the temperature may be, when the house is first shut up, from 45° to 50° at night, and 55° to 60° by day; and by the end of the month it should be gradually raised 5° higher, or to 50° or 55° at night, and 60° or 65° in the day. This may either be attained by heating materials, such as tan, or a mixture of dung and leaves in the floor of the house, or by a little fire-heat. Syringe the vines twice a-day, and sprinkle the paths and flues occasionally, so as to maintain a moist atmosphere. If vines in pots have started for some very early fruit, the shoots should be stopped when they have grown 1 foot in length. After the leading shoot is stopped, the lateral will push from the joint to which the shoot was stopped. This lateral, if allowed to grow, would form a leader, but it would be a weakly growth compared to that of the original shoot. Close to the base of the lateral, a bud will, however, be observed, which is the principal one,

but it would not break till next season, if the lateral were allowed to go on; therefore, the latter must be pinched off almost close to its base, and then the principal bud will start.

Figs.—After the crop is gathered, the plants should be gradually subjected to a lower temperature, and then shifted if necessary; or at all events the top soil should be taken off and replaced with fresh. The pots should then be placed in an airy house or shed, where the temperature can be prevented from ever falling below 40° . Of course, water will scarcely be required under these circumstances, but the roots must not be allowed to get too dry.

Peaches and Nectarines.—The trees should be freely exposed to the air. The sashes may even be taken off in the early part of the month, and this will afford an opportunity for repairing and painting them.

Cherries.—Examine the trees, and shift all those requiring more room for their roots into larger pots or tubs. Top-dress the others. Plunge in leaves, or otherwise mulch, so as to protect the roots from frost.

Strawberries.—The pots should be protected from frost, and also from heavy rains, which would wash the nutritive principles out of the soil, unless the rain pass through a mulching of leaves or long dung. The pots may therefore be placed under a roof, or piled horizontally, or placed in a frame.

IV.—FLOWER GARDEN AND PLEASURE-GROUNDS.

The general appearance of this department cannot now be so gay as it was in the six previous months, when a rich display of flowers in the beds and borders contrasted with the smooth green lawn, and clean, well-rolled gravel walks. But the beauty of the lawn and walks may still be continued, provided they are well kept according to the usual routine, and are frequently cleared of fallen leaves. The expense of removing the latter is partly compensated by their value as manure, or for heating and protecting. The beds and borders should likewise be cleared of annuals done flowering, and of all decayed portions of herbaceous plants. Where no material alterations are intended, all the borders and beds should be kept raked; but if alterations are to be made, now is the time to proceed with them—the earlier in the month the better, provided the ground is in working condition; for this is the most favourable

season for planting most kinds of ornamental trees and shrubs. Plants that grow in peat soil, such as rhododendrons, azaleas, kalmias, &c., are, however, more safely planted in spring. Unless the ground be wet, roses and all deciduous shrubs are best planted in the present month. Stake newly-planted trees that would be in danger of having their roots disturbed in consequence of wind. Prune and nail creepers. Deciduous trees and shrubs are generally best pruned as soon as their leaves have fallen. Any movement of sap that does take place is then wholly directed towards the buds that are left, instead of being distributed among these and others along the entire shoot; the former, consequently, break with greater vigour in spring, and produce stronger shoots. Although an early frost may have somewhat blackened the foliage of dahlias, the plants may still remain in the ground; for the longer they can do so with safety, the better. When the weather renders it absolutely necessary, they should be taken up. Choose a dry day; cut the stems to within 6 or 8 inches of the ground; dig up the roots, and place them with the stem downwards, so that the water which drains from it may not lodge upon the tubers. Finally, place these in a dry cool place, yet secure from frost. Take up any other plants that may be too tender to remain in the ground all winter, such as fuchsias, calceolarias, &c. In some localities, the *Fuchsia globosa*, and others of like habit, may be left in the ground, if protected with leaves or long dung. Many newly-planted shrubs that are not very hardy, should have a mulching put over their roots. Some kinds should be protected by mats or straw covering; or if these be thought unsightly, wicker cases lined with straw will perhaps be less objectionable as regards appearance, and will answer the purpose equally well. Although rustic, they may have, notwithstanding, a certain regularity of general outline. Plant hyacinths, tulips, anemones, ranunculuses, snowdrops, jonquils, scyllas, narcissuses, lilies, and other hardy bulbs. Protect the beds of finer sorts from rain till the bulbs have struck root.

Fibrous-rooted perennials and biennials may also be planted now, and they generally have larger flowers than if their removal were delayed till spring; but the planting of any scarce sort had better be deferred till that period, in case of accidents during winter.

Clear off suckers, and plant such kinds as it may be desirable to propagate.

Thin annuals, and transplant patches of them where vacancies occur.

V.—PITS AND FRAMES.

At this season, when light is so scarce, the glass should be kept as clear as possible by washing or syringing.

Cover up well at night the pits that are not heated. Water in the early part of the forenoon, and as sparingly as possible. Introduce bulbs, rhododendrons, roses, Persian lilacs, and other plants for forcing.

Auriculas.—Give plenty of air on all favourable occasions. Water very moderately, but take care that the ball of earth do not get dry in the centre.

Calceolarias.—Seedlings that have filled their pots with roots should be shifted.

Carnations and *Picotees*.—Take off the lights in fine weather; give air also in mild wet weather, but so as the plants may not be exposed to rain. Cut off decayed leaves.

Cinerarias.—Give plenty of air and space, and keep the plants near the glass. Green fly must be destroyed if it appear.

Verbenas.—Remove sickly plants from the general stock, likewise any that are affected with mildew or green fly; dust these with sulphur, and fumigate. Water with great care at this usually damp period of the season.

VI.—GREEN-HOUSE.

Frost at night may now have to be guarded against; but more so, the effects of a constantly saturated atmosphere, for if these are not counteracted, the whole stock of plants will be more or less injured by damp. The floor should be kept dry, and occasionally fires should be lighted in the mornings, when the weather is likely to be such as to admit of plenty of air being given as the heating apparatus gets warm. All dead leaves and shoots should be removed. In short, no decaying substance that would contaminate the air of the house should be allowed to remain in it. When the leaves of camellias, oranges, &c., require to be cleaned, the plants should be taken out, if not very large, and sponged and syringed in a shed, replacing them when they are dry in the green-house. In order likewise to prevent the plants from

being injuriously affected by damp, they should not be crowded so that the air cannot freely circulate amongst them. In the period of the season when all the plants are in active growth, the whole could with propriety be watered indiscriminately at the root, and all equally syringed; but now, watering must be restricted to such plants as are seen to be absolutely in want of it, and any general application of water must be avoided. Let the sides of the pots be cleaned when mouldiness appears upon them, and top-dress when the surface of the soil in the pots has not a fresh appearance. The flower-buds of chrysanthemums should be thinned, if too numerous; a somewhat liberal supply of water should be given, and an occasional application of weak liquid manure will be attended with beneficial effects. If a sufficiency of the modern sorts are cultivated, the house will begin to present a gay appearance. Pelargoniums requiring shifting, if not attended to last month, must be repotted immediately into the next size of pot. They do not require heat that would stimulate them into growth, but the air of the house should be kept several degrees above the general temperature of the external air. A temperature of from 40° to 45° would be desirable; but the weather may be mild and damp, with the external temperature above 45° , in which case fire-heat, though not required on account of temperature, should nevertheless be applied moderately during the day, with air, to dispel damp. Water sparingly, and if the soil in any of the pots has become saturated, the circumstance may be detected by tapping on the outside of the pot; it has a more solid sound when the soil it contains is saturated than when it is otherwise. Should it continue in the former condition for some time, although no water be given, the foliage will acquire a yellowish hue, and the roots will get into a bad condition; but before this takes place, it will be advisable to shift the plant, using rather dry soil.

VII.—PLANT STOVE.

This being usually a sunless month, the temperature should be lowered, to correspond with the limited amount of light, as far as is consistent with the conditions of temperature to which the plants are exposed in their native countries. This, however, is difficult to determine; for a collection of plants, originally

from within the tropics, may nevertheless come from localities varying greatly in temperature, according to elevation above the level of the sea. For example, at Pondicherry, lat. $11^{\circ} 56'$, the mean temperature of the month is about 81° ; whilst at Ootacamund, lat. $11^{\circ} 25'$, it is only 56° , a difference of 25° , owing to elevation, Ootacamund being between 7000 and 8000 feet higher than Pondicherry. So that, although both places are within the tropics and almost equally near the equator, yet plants from the one place would require a stove, and those from the other only protection from frost, in a green-house, during winter. In the tropics, therefore, between the level of the sea and that elevation from which plants are nearly hardy, there are many gradations of climate, the plants from which would require differently heated compartments. But they have generally to be divided between the stove and green-house. In the former, plants from the hottest tropical regions must be accommodated, and also some requiring less heat, but for which the green-house would prove too cold. These, should of course, be placed at the cooler end of the stove. A temperature of between 50° and 60° would be sufficient for them; but on account of those plants for which a temperature of between 70° and 80° is natural in this month, 10° below that, or a mean of 65° , is as much reduction as can well be allowed, however desirable it may be to proportion the amount of heat to that of light. If by sun-heat the temperature should rise to 75° , air should be admitted, taking care to reduce the quantity, or to shut up when the thermometer begins to fall below that point. The minimum at night should be 60° . In order that less fire-heat may be necessary to keep up the required temperature, it would be desirable to put a covering of frigi-domo on the house at night. This would save fuel, and prevent the air of the house from becoming too dry, and consequently the health of the plants would be better maintained than would otherwise be the case when much heat from fire is employed, and much dissipated at the same time by radiation from an exposed surface of glass. Water sparingly. Plants that are nearly dormant will scarcely require any. If the weather is clear, take the opportunity to syringe the plants in the morning. Wash the glass occasionally, to admit all the light possible. Destroy insects by sponging, fumigation, or other means.

DECEMBER.

County.	Place.	Latitude.	Longitude.	Mean Temp.	Rain in inches.	No. of Years' Observations.
Cornwall...	Penzance...	50° 7'	5° 33' W.	45·16	6·03	21
Middlesex...	Chiswick...	51 29	0 18 W.	39·48	1·47	30
Gloucester...	Stroud.....	51 45	2 13 W.	38·60	2·62	30
Lincoln.....	Boston.....	52 48	0 5 W.	39·94	1·47	20
Dublin.....	Dublin.....	53 21	6 11 W.	42·02	...	17
Lancashire...	Liverpool..	53 25	2 59 W.	41·67	...	25
Dumfries ..	Applegarth	55 13	3 12 W.	38·12	2·39	19
Mid-Loth..	Edinburgh.	55 48	3 11 W.	41·00	2·40	20
Aberdeen ..	Aberdeen...	57 9	2 5 W.	40·18	...	8
Orkney.....	Sandwick...	59 5	3 17 W.	41·18	4·13	26

I.—KITCHEN GARDEN DEPARTMENT.

Frost usually occurs in this month sufficient to harden the ground, so that it will bear to be wheeled upon, at least in the mornings. Advantage should be taken of that condition to put manure on quarters where it is wanted, for it can then be done not only with greater facility, but without puddling the ground, which should at all times be avoided. Such opportunities should also be taken to wheel out soil that has to be removed in taking out openings for trenching. Frost in these respects is beneficial; but, on the other hand, its effects must be guarded against as regards various things liable to be injured by it.

Collect all decaying substances in heaps for manure, and these may be turned when the ground, either from frost or wet, is not in a condition to be worked. These substances ought to be brought, by turning and mixing, into a state of fermentation before they are put on the ground; and, after all, it is advisable to put such manure in the bottom of trenches where root crops are to be grown, rather than use it for crops that require manure nearer the surface. In wet weather diligently forward all work that can be done in-doors, so that it may not be to do when the weather is fine. Pea sticks cut before the sap rises are stronger, and not so apt to rot, as those cut after it begins to move. They should therefore be now brought in and prepared, sorting them into lengths to suit the respective heights to which the different kinds of pease grow. Then tie them up in bundles that can be conveniently carried, and place them under cover, but where air may freely circulate, till they are required for use. In bad weather tallies should be prepared for painting, to be afterwards written with the names of seeds sown, or crops planted.

Beans.—Draw earth to the stems of those a little above ground, to protect them from being tossed about by the wind. See that there is no cavity formed that would hold water about the stem.

Celery.—Finally earth-up in dry days; but if the soil is of a heavy nature, some that is light and dry should be put next to the plants, placing it against them with the hand. Protect from frost with straw, or by means of hoops and mats, or a thatched roof that may be raised or lowered according as the weather is fine, or the contrary.

Endive.—Continue to blanch in succession. Protect with flower-pots or otherwise; likewise take up some and plant in sheds or frames.

Jerusalem Artichokes.—These may be taken up as required fresh out of the ground; but, in case of frost, the latter should be covered over with litter.

Onions.—Pick over those that are housed in wet weather. Keep them cool, but protect from frost.

Parsley.—In case of frost, a portion of the best should have a frame, or other protection placed over it.

Pease.—Draw some earth to those a little above ground. Sow a succession. Guard against the attacks of mice. These may be caught in traps sometimes; when they are, give them, at intervals, to a cat on the spot.

Radishes.—Sow in light soil on a sheltered border, and cover with straw or litter, turning it off in the day and replacing it at night.

II.—HARDY FRUIT DEPARTMENT.

The planting of all sorts of fruit-trees recommended to be done last month, but not completed, should be proceeded with as early as possible in this, provided the soil is in proper condition—that is to say, neither too wet nor frozen. Pieces of frozen crust, thrown in with the soil in planting, condense moisture, owing to their coldness, and form wet, chilling masses, even after being thawed. This kind of moisture, in contact with the roots, is unquestionably worse for them than that from drenching rains.

Continue to trench and prepare ground for planting, and to make new borders where such are required, or renew old ones. It is

also a good time to trench in advance of the roots of wall-trees that have commenced bearing, introducing, at the same time, some new soil, or compost formed of fresh loam and manure; for this is better for fruit-trees than manure alone. Mulch over the roots of newly planted trees, and stake such of these as would otherwise be shaken out of their position by the wind. Continue to prune all sorts of fruit-trees, except figs and nuts. If the shoots of peaches and nectarines, on an east or west aspect, are green and immature, the pruning of them may be deferred till early in spring. Old trees, intended to be re-grafted, should now be headed back. Their branches should be sawed off almost close to the place where each can be most eligibly grafted. When gooseberry and currant trees are pruned, and the cuttings raked off, manure should be wheeled between the rows, and dug in; but, in doing this, the surface should be drawn clean away from near the stems, and buried in the middle of the space between the rows.

Clean trees from moss. After wet weather, their stems, and the naked parts of branches, can be easily scraped, scrubbed, and washed clean.

Nail wall-trees in favourable weather. See that no more nails are used than are absolutely required, and that they are driven, not into the faces of the bricks, but into the mortar, and no further into it than is necessary to insure sufficient hold. Nails, whether new or old, should be heated, and plunged, when under a red heat, in linseed oil. Old shreds that have been picked out as being again fit to be used, should be boiled, to kill insects, then thoroughly dried, and laid aside till wanted.

The fruit-room should be kept close at night, and also during the warmest period of any day that happens to be so much warmer than usual as to cause condensation. Remove all specked and decaying fruit; but, in so doing, disturb as little as possible that which is sound.

III.—FORCING DEPARTMENT.

Asparagus.—Continue to maintain a bottom heat of from 60° to 70°; and, when the buds have started, the soil may be watered according as it may be necessary; but the water should not be cold, as, in that state, it would check the growth. It should be brought to a temperature of about 65°. Add some more

light, dry soil, and, when the shoots appear, admit air and light, the latter being necessary, that the shoots may acquire the natural green. Asparagus that is being forced on established beds, should have the linings turned when the heat is likely to fall below the degree above-mentioned; and, before the shoots advance to be in danger of breaking, the soil in the frame should be forked over, and finely broken. Water will not likely be required; but, if it should, to gently moisten the surface, attend to the directions for its application to asparagus in frames. Prepare for forcing a succession.

Cauliflowers.—Protect from severe cold, so as to keep the plants from being checked; but, on the other hand, take care not to render them tender, by not giving abundance of air.

Chicory.—Take up roots, and plant for succession, as before directed.

Cress.—Keep up a supply, by sowing in boxes placed in heat.

Endive.—Introduce plants nearly full grown into a warm frame or pit to blanch. Give plenty of air to those growing in protecting frames.

Kidney Beans.—Sow in succession.

Lettuce.—Keep the glass clean, in order that it may transmit the more light to the plants. Give air freely in all favourable weather. Some may be planted in rich soil, in pots, and placed in a frame. They may come forward, and prove useful, in case others planted in the beds should damp off.

Mint.—Plant in pots or boxes for forcing.

Mushrooms.—Attend to former directions, as regards a moist atmosphere in the house. Any in ridges out of doors, will require to be thickly covered with litter and mats.

Mustard.—Sow, and place in heat.

Radishes.—Prepare a slight hot-bed. Cover it with several inches of rich compost, over which lay 5 or 6 inches of light soil, and, in this, when the bed is at a proper temperature, 60° to 70°, sow some of the Red and White Turnip radishes, and some of the Oblong Rose-coloured. The frame should be so far made up with the dung and soil, as to have the surface of the latter near the glass. Give air when the plants come up, and take care that they are thinned in time.

Rhubarb.—Roots should be taken up every fortnight or three weeks, and put in heat for a succession, or hot dung may be used for

forcing plants in the ground under a large inverted flower-pot.

Sea Kale.—The same remarks as for rhubarb are applicable to this.

Sorrel.—Pot French and Broad-leaved for forcing.

Cucumbers.—A bottom heat of 75° was recommended last month for those planted out in pits or frames, and a top heat about the same, or as much as 80°, with sun-heat and air. As the plants advance, let these temperatures be fully maintained, especially if the days are clear. In this case, the heat may be increased 5°; but it would be desirable that, once every day, the top heat should be higher than the bottom heat, and, if this can be effected by sun-heat, with air at the same time, it would be far preferable to obtaining the same amount of temperature by closing the sashes. Air should be carefully admitted, and always, except in case of very cold and cutting winds, when enough will be insinuated beneath ordinary fitting sashes, although these may be untilted. In calm frosty nights, very little indeed should be given. The plants should be as near the glass as possible, and it should be kept warm by a good covering, either of straw mats, or a layer of hay under common mats. Attend to stopping and training. If the foliage is allowed to get crowded, a portion of the leaves will acquire a yellowish tinge, and will soon become worse than useless. Be careful, therefore, to prevent this. Ascertain that the water supplied is of the proper temperature, 75°, or not higher than 80°. Cucumbers in boxes should have occasionally diluted manure water, also warmed. A seed-bed, adapted for a one-light box, may be prepared. It will be useful for raising cucumber plants, and other things, where beds have not been set to work, nor hot-water apparatus in use.

Pine Apples.—The temperature recommended for last month should be generally continued. A bottom heat of from 70° to 75° will maintain the roots of young stock in a slight degree of activity, sufficient to keep them alive, and the top heat for these should not fall below 65°. Cover at night, so that less fire-heat may be required; for the less of it the better, provided the proper temperature is insured, allowance being also made for affording a little air on favourable occasions. Plants in dung frames will require to have the linings turned; and, towards the end of

the month, these should be substantially made up, so as to be in condition to counteract the great degree of cold which usually occurs in January. That the heat may be steady, a good bulk of materials will have to be employed; and, that it may not be too violent, the dung should be mixed with leaves, those of oak, beech, and others of firm texture, being preferable. The linings should be covered from cold, drenching rain, and snow, or, if this cannot be done, long litter should be laid on, so as to throw off the wet. If it is desired to start some plants early, they should be placed in a bottom heat of 85°, and it may be raised to 90°. This, with a top heat of 84°, and the soil and air rather dry than otherwise, will likely cause them to show for fruit. Plants that are swelling fruit, should have water in proportion to the demand which a comparatively high temperature will occasion. Syringe, and shut up with a hot and moist atmosphere.

Vines.—The temperature of the house commenced to be forced last month, should be kept gradually on the increase. That of 60° to 65° by day, and from 50° to 55° by night, was the temperature recommended at the end of November. The day temperature may now be increased by 2° a-week, and the night temperature 1° a-week, till the end of the month. Fire-heat will require to be applied. The pipes or flues and pathways must be frequently sprinkled to produce a moist atmosphere, and the stems should be syringed with water of the same temperature as the air of the house. If the vines have been planted outside, take care that the portion of the stem is well protected from cold; but dung should not be allowed to come in contact with the stem, and, whilst care is taken to protect the outside portion from cold, that which is inside must be guarded from too much heat from the pipes or flues over which it may be situated. A screen, of some material that is a slow conductor of heat, should, therefore, be placed between it and the flue. Very little air will be required till the buds begin to break, but it must then be given at every favourable opportunity; and if any of the vines have been bent down, with the view of inducing them to break near the bottom, they must be raised near the light.

Figs.—A few of those in pots may be plunged in moderate bottom heat, or they may be placed on fermenting materials, if

such have been introduced in the floor of the early vinery. The plants to be thus forwarded at this season need not be large; for the fig can be fruited although kept in small compass, provided the extent of foliage has been kept in such limited proportion as to correspond with the space allowed for its roots.

Peaches and Nectarines.—The temperature of the earliest house should be kept so as to induce a gradually progressive vegetation in the trees; for these will not bear to be rapidly forced in the early stage of the process. It should be recollected that they blossom in the open air at an early period of the season, when the temperature is consequently not high, and if they are subjected to much fire-heat, the blossoms will drop. The temperature at night should be from 45° to 50° , and 55° to 60° during the day, and it may be allowed to rise to 65° by the aid of sun-heat; but abundance of air must be given. Sprinkle the trees with water as warm as the air of the house, in the mornings and afternoons, and continue this till the flower-buds begin to open.

Cherries.—The trees should be taken in, and the house shut up; but the temperature must be kept very moderate. About 45° at night will be sufficient in the first instance, and 55° by day, or 60° by sun-heat, plenty of air being then admitted. The pots should be placed in leaves that will afford a mild bottom heat of about 55° .

Strawberries.—Protect the pots from frost. Some may be introduced into the peach-house.

IV.—FLOWER GARDEN AND PLEASURE GROUNDS.

If the planting recommended to be done last month has not been completed, it should be proceeded with in the beginning of this, weather and state of the soil permitting. Any intended alterations should also be forwarded, and for these, frosty weather may, in some cases, be advantageous, by allowing the wheeling of soil and manure without cutting up the walks. The leaves of deciduous trees having fallen, none should be left to blow about with the wind. Those lurking in the shrubberies should be dug in. The walks should be kept well rolled, and their edgings nicely cut, and likewise those of the beds and clumps. The latter should be dry, or rough dug, where empty, and they will have a better appearance than if they were now hoed and

raked. If in some places rough digging should be objectionable, as when the figures or beds are small, these may be neatly dug, but not raked. There is an object in having the soil more or less rough at this season, that it may be mellowed by the weather; but there is no reason why the edges should not be kept quite as neat in winter as in summer.

Prune hardy roses. Those pruned now will push more vigorously than if left till the sap is rising in spring; but if any are required to flower later than others of the same sort, their pruning ought to be deferred till the upper part of the shoots have pushed a little in spring; for the sap will flow towards the extremities without exciting much the buds situated near the base; but if the shoots were now shortened, the sap would be wholly directed to the development of the buds left below, and they would consequently push much earlier. This remark applies to trees and shrubs generally. Hedges of hawthorn, or others that are deciduous, should now be pruned or trimmed, and in doing so, take care that the hedge is formed narrower at top than at bottom. They should, in fact, be tapered to single shoots, and in young hedges, the line of shoots should be cut first to a uniform height, and then every other one should be cut lower. Lateral shoots break out most abundantly just below the places to which the leading shoots are cut back, and if these were all shortened to the same level, the hedge would be more crowded at that particular place than elsewhere. It is, therefore, better to cut so that a portion of the lateral shoots may be produced lower down.

Prepare composts by turning and mixing. In some cases exposure to frost is beneficial. Prepare number sticks, tallies, shreds, &c., in bad weather. Sweep off, as clean as possible, the snow from walks, in order that they may be comparatively dry when the sun shines, or when a thaw takes place. If snow lodge heavily on trees and shrubs, so that they are in danger of being broken down, let them be relieved of their load. See that all plants liable to be injured by frost are duly protected.

V.—PITS AND FRAMES.

As a general rule, all half-hardy plants quartered in these structures should have abundance of air during the day when the weather is not too severe. But when frost sets in, this

merely sheltering portion of the pits should be well protected by good covering; for not only will the plants be thereby secured from a degree of cold which would injure them more in confinement than the same degree would their fellows in the open air, but the interior of the pit will be kept warmer than would otherwise be the case; so that, when a thaw comes, less condensation of moisture will take place within them, and, consequently, there will be less damping of the plants than is the case when a great disparity of temperature exists between the substances within the pit and the external air. With regard to those pits which have fire-heat afforded, the proper degree of heat can be maintained, whilst air can be admitted to dispel damp. The danger is, that the air at night may get too dry for the plants. It will be lessened by employing a warm covering at night, so that less artificial heat will be necessary.

The forcing pits, or those in which the highest temperature, as regards both top and bottom heat, is obtained, will require great attention in the regulation of these, so that they may bear a due proportion to each other. The mean of the bottom heat should exceed that of the top heat by a few degrees. The bottom heat may be 80°, or nearly so, whilst the top heat may range from 68° at night to 75° in the day, or by sun-heat 80°, with air at the same time. In these, a succession of flowering plants should be brought forward, such as various kinds of bulbs, rhododendrons, azaleas, roses, &c.; but it is always advisable to introduce plants that are not tropical to a more temperate medium, for some time previous to plunging them in the forcing pit.

Auriculas.—Protect from rain, but admit plenty of air when the weather is at all favourable. Severe frosts must be guarded against by covering at night.

Calceolarias.—Some of the more forward of these will probably, on examination, require to be shifted. Water moderately, but take care of damp. A little fire-heat and ventilation will dispel it.

Carnations and *Picotees*.—Those in frames should be kept clean and dry. Water will scarcely be required, but abundance of air must be afforded.

Cinerarias.—Pinch the tops where branches are wanted to form a spreading top. Some of the more forward may be introduced to a warm pit for early flowering.

Pelargoniums.—Towards the end of the month, stop all the shoots of those intended for flowering in June. Train out the shoots, so that the leaves may receive as much light as possible.

Violets.—Protect from frosts, heavy rain, and snow; but let them be entirely uncovered when the weather is at all favourable.

VI.—GREEN-HOUSE.

It is desirable that this house should be kept as gay as possible at this dull season of the year, when little of floral beauty can be seen out of doors. Pits and frames are, or ought to be, very useful contributors of flowering plants to the green-house; but the plants so furnished, having been forwarded in more or less heat, are not well adapted for the cool temperature that would be suitable, at this season, for various hard-wooded green-house plants. Many of these would require no artificial heat, provided the air of the house did not fall lower than within a few degrees of freezing. But, on account of the introduction of plants requiring more heat, as above alluded to, the temperature at night should be about 45°, although, in severe weather, rather than employ much fire-heat, the temperature may fall to 40°, but certainly not lower, and it may rise to 50° or 55° in the day. A covering of frigi-domo will prevent the escape of heat to a great extent, and fire-heat to that extent may, consequently, be well dispensed with. Endeavour to maintain a moderately dry atmosphere during the damp weather which is usually prevalent at this season. When fire-heat is but little required, watering will seldom be necessary, and it must be given only where absolutely wanted, more, of course, to the growing plants than to those which are comparatively dormant. Heaths and New Holland plants must be watered very sparingly. Give air at every favourable opportunity in the early part of the day, shutting up as soon as the temperature out of doors begins to fall in the afternoon. Clean the foliage from dust, and the pots from moss. Destroy insects on their first appearance. Remove plants that have done flowering, and replace, from the pits, with others coming into bloom.

VII.—PLANT STOVE.

The temperature should be kept comparatively low, as was recommended for last

month. Nothing should be done to excite vegetation; but, at the same time, its powers should not be so much lowered or paralyzed by cold, as to render the plants incapable of resuming a vigorous action at the proper season. The temperature should therefore range not lower than 60° at night, and it should be kept down to 65° by day, or by sun-heat to not higher than 70° . When it reaches 65° , air should be given, however little may be necessary, and it should not be admitted in currents. If the temperature rise to 70° after two p.m., the house may be shut up, that less fire-heat may be necessary, and so much of its parching effects avoided. Although the house should be kept rather dry, yet the air must not be allowed to

become too dry, which is apt to be the case, especially at night, when much fire-heat becomes necessary. A warm covering, such as frigi-domo, will be of great advantage; for it not only renders less fire-heat necessary, but, by keeping the glass warm, it prevents its depriving the air of the house of moisture, by rendering it less capable of acting as a condenser. Plants that are taking a somewhat active growth, will require more water than those which are naturally inclined to rest. Bulbs that have lost their leaves should be kept dry. See that the foliage of all plants is kept clean and free from insects; and that it may have as much light as possible, let the glass be washed from soot or other substances affecting its transparency.

THE GARDENER'S ASSISTANT.

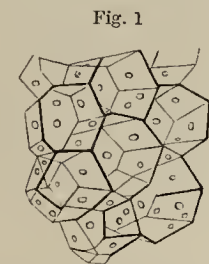
CHAPTER I.

THE PRINCIPAL ORGANS OF PLANTS.

I.—ELEMENTARY ORGANS.

ORGANIZABLE MATTER, *Organic Mucus*, or *Cambium*, is a viscid secretion present in all the living parts of plants, and from it all their organs are formed. It is most readily observed between the bark and wood of exogenous trees in spring. From this substance a cell is formed, and the earliest condition of a plant is a single cell. When the cell is first observed it appears like a little sac or bladder, circumscribed by a single continuous membrane; it may continue as such, or another layer may appear in the interior of the first, and the thickness of the wall of the cell may be further increased by the addition of a third, fourth, or more internal layers.

As growth proceeds, other cells are rapidly developed, in contact with each other, of a globose or spheroidal shape; but when pressed closely together in their growth, they, in many cases, assume a do-decahedral or other many-sided form, as represented in Fig. 1. When the cells are not compressed in their development, intervals exist between them, which are called intercellular spaces; but these are frequently occupied with



Elder—Cellular Tissue of Pith.

The substance forming the walls of the cells is called *cellulose*; it is produced from the organizable matter, and is a compound of 24 equivalents of carbon, 21 of hydrogen, and 21 of oxygen. It is represented by the formula $C_{24}H_{21}O_{21}$. An assemblage of cells constitutes *Vegetable Tissue*, such as may be

observed on examining with a microscope a very thin slice of the stem, root, or leaf of any plant. It assumes various forms, the principal of which are:—1. Cellular Tissue; 2. Pitted Tissue; 3. Woody Tissue; 4. Vascular Tissue; 5. Laticiferous Tissue.

1. *Cellular Tissue*.—This consists of a number of cells packed together, and apparently having no communication with each other, though it is supposed that their walls are pierced by innumerable invisible pores. It constitutes the whole of some plants, as in algæ and fungi; and is present more or less in every living part of the vegetable structure. Two forms are distinguished—namely, the *membranous* and the *fibrous*; in the former, the sides of the cells consist of membrane only; in the latter, of membrane and fibre, or of fibre only. It is considered to originate from the preceding, which is the only form indispensable to plants, and never absent from them.

Fig. 2.



Clematis—Pitted Tissue.

2. *Pitted Tissue* (Fig. 2) is composed of tubes of comparatively large size. The sides are marked with pits, having the appearance of dots arranged at tolerably regular distances. There are usually slight contractions in the tube, which is formed of a series of cells united at their end by the absorption of their transverse dissepiments. Tubes of this kind of tissue sometimes extend nearly the whole length of the plant.

3. *Woody Tissue* consists of long slender tubes placed closely side by side in bundles; but the fibres terminate conically, and consequently leave intervals. The individual tubes are hollow, at least originally, when they consist of a single

membrane; but usually several layers are successively formed in the interior till scarcely any cavity is left in the centre. Woody tissue constitutes the principal part of the wood of plants; it also abounds in the liber.

4. *Vascular Tissue*.—This consists of membranous tubes, tapering at the ends, and having a fibre coiled in the inside. The coiled fibres are either regular spirals, or they form irregular spiral rings or bars. Two principal forms of this tissue exist, namely, *spiral vessels* and *ducts*.

The spiral vessels contain a spiral thread,

generally winding from right to left, and which may be drawn out without breaking like a coiled wire spring, as represented in Fig. 3. On gently pulling asunder the young shoots of the elder, or rose, or the stalk of a strawberry leaf, the lower portion will remain suspended from the upper by extremely fine threads, which are the spiral vessels unrolled.

Ducts (Figs. 4 and 5) are composed of a membranous tube containing fibrous rings, spirals which cannot be drawn out, or bars extending over a portion of the circumference of the tube.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.

Fig. 3. Melon—Spiral Vessels.

Fig. 4. Melon—Ducts.

Fig. 5. Melon—Ducts.

Fig. 6. Celandine—Laticiferous Tissue.

Fig. 7. Dandelion—Laticiferous Tissue.

5. *Laticiferous Tissue*.—This consists of membranous tubes, which are extremely fine and thin-sided when young, but becoming larger and thicker sided, with contractions at intervals, as they grow old. They contain the latex, or proper juices of plants, such as the milky juice of the fig and lettuce. Fig. 6 represents this kind of tissue in the celandine; Fig. 7 in the dandelion.

It has been seen that vegetable tissue contains numerous cavities, both in the form of cells and spaces between these. They are variously occupied during the growth of the plant, some containing air only, others, as in Fig. 8, acting as receptacles for the secretions of the plant, such as starch sugar, and gum, as well as chlorophyll,

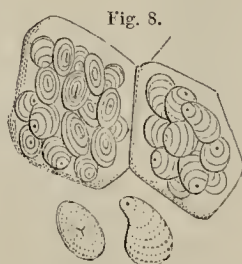


Fig. 8.

Pea—Amylaceous Cells.



Fig. 9.

Beet—Cell containing Raphides.

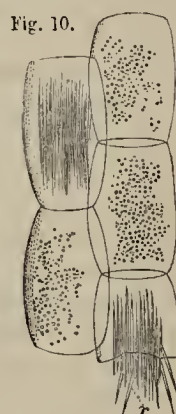


Fig. 10.

Rumex—Cells containing Raphides.

or the green colouring matter of plants. Besides these substances, minute crystals, called *raphides*, *r* (Figs. 9 and 10), are found in the tissues of the stem, bark, leaves, fruit, and other parts of most plants. They chiefly consist of vegetable acids united with lime and magnesia, and of phosphate of lime. Raphides are very abundant in the roots and leaves of rhu-

barb, and they are likewise found in grapes.

Having given some idea of the elementary tissues of plants, we may now proceed to the consideration of the plant itself which is formed by the combination of these tissues. A plant before it begins to grow exists

as an *embryo*; when growth commences, it elongates in an upward and downward direction; the part which strikes downwards is called the descending axis, or *root*, and the part which goes upwards is called the ascending axis, or *stem*; the intermediate space between the root and stem, and from

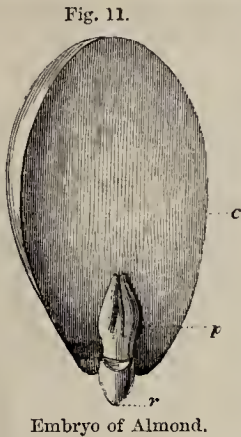


Fig. 11.

Embryo of Almond.

which these two organs take their rise, is called the *crown* or *collar*. Fig. 11 is the kernel of an almond which has germinated so far as to exhibit, when one of the lobes is removed, the radicle *r*, or descending part, which forms the root, and the plumule *p*, or ascending part, which forms the stem and its ramifications. The remaining cotyledon is marked *c*.

Previous to noticing these organs, it is necessary to mention one which is common to both, the *epidermis*, a thin transparent covering, which extends over the whole of their surface. It is composed of two parts, separable on maceration, which are the epidermis, properly so called, and a thin pellicle, called the *cuticle*, everywhere covering it. The epidermis proper consists of cellular tissue, the cells of which are usually more firmly attached to each other than to those of the subjacent tissue. They are generally disposed in a single layer, and are frequently of an hexagonal shape, but are also very commonly bounded by sinuous lines, as in Fig. 12, which represents the epidermis of the garden balsam. In some plants, as fungi and mosses, it is absent, or at least not distinguishable; in aquatic plants it is only found on such parts as grow above water; thus leaves which float upon the surface have an epidermis upon their upper side, and none upon their under side. The spongioles of the roots, and stigma of the flower, have no epidermis. The cuticle is a thin continuous membrane, covering the epidermis at every part. It is found more generally than the epidermis, being found in plants having no such covering.

In the cuticle and epidermis of plants, numerous spaces, called *stomates* (Figs. 12 and

Fig. 12.

Fig. 13.

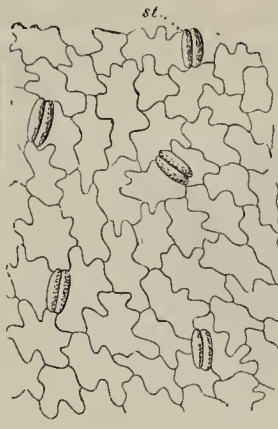


Fig. 12. Balsam—Epidermis and Stomates.

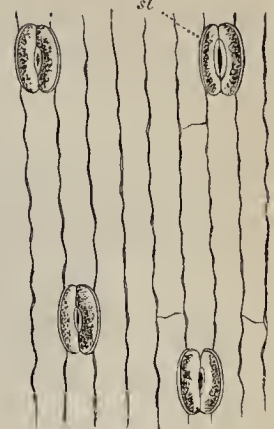


Fig. 13. Lily—Epidermis and Stomates.

13), exist. They are generally oval in shape, and have an opening in the middle, bounded by two oblong, slightly curved bodies, somewhat resembling lips, which open and close according to their state of humidity or dryness. Stomates appear to be connected with the functions of respiration and perspiration; they are most abundant on the leaves—those of *Hydrangea quercifolia* and *Syringa vulgaris* have as many as 160,000 in one square inch of surface. They are met with in all plants having an epidermis, but are not found in parts destitute of that covering, nor upon roots, neither do they occur upon plants growing in the dark.

II.—THE ROOT.

The root is that portion of the plant which directs itself towards the centre of the earth, and serves to fix the plant in the soil, drawing from the latter, nourishment necessary to the growth of the plant. It consists of a main trunk, from which proceed numerous ramifications called *fibrils*, at the extremities of which are situated little swellings of cellular tissue and mucus. These absorb fluids with great force, and are called *spongioles*. They must not, however, be considered as forming a distinct organ; they are merely young tissue in a forming state. The spongioles and fibrils are the most important part of the root; for the main body of the latter draws but little nourishment from the soil, absorption taking place almost entirely through the younger portions. "We already know,"

says M. Du Breuil, "that the property of suction lies in the extremities of the roots. To prove the truth of this assertion, a young tree was placed (Fig. 14) so that the fibrils or extremities of the roots were alone plunged in water, whilst the body of the roots was

merely kept from contact with the external air. The tree continued to vegetate. The reverse was then tried—that is to say, the body of the root was placed in water, whilst the fibrils were kept from contact with it, as in Fig. 15. In this case, vegetation suddenly

Fig. 14.

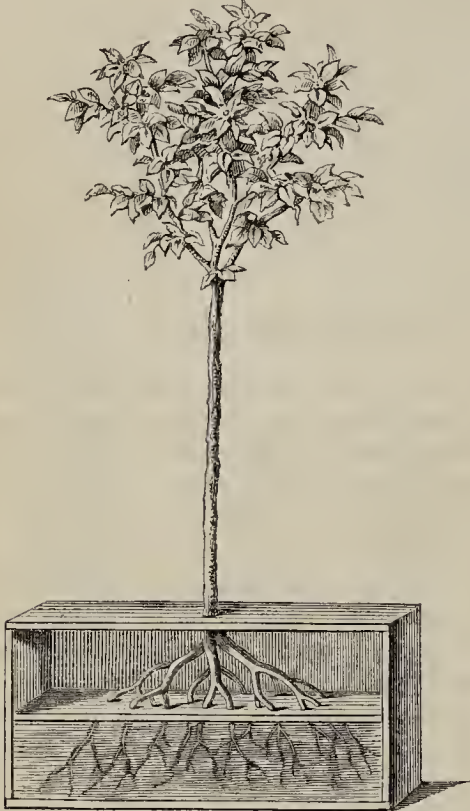
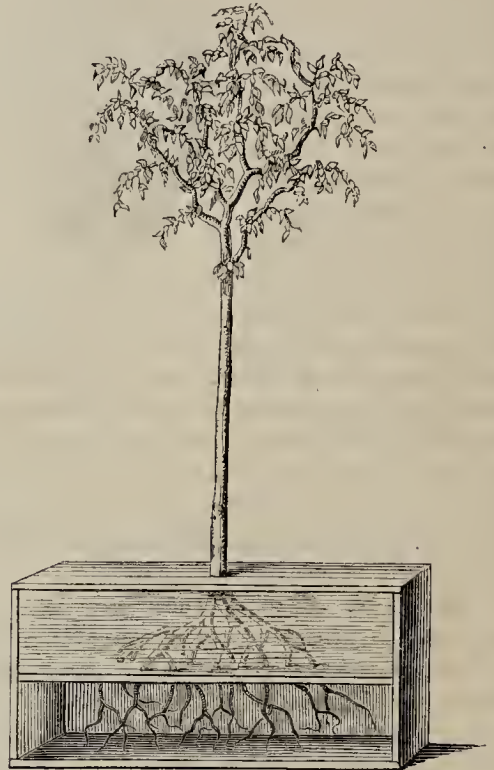


Fig. 15.



Figs. 14 and 15. Experiment of Absorption through Spongioles.

stopped, and the leaves withered."—(*Cours élémentaire d'Arboriculture*.)

The forms of roots are various: when the

called *fibrous*; when the main root is fleshy, elongated, and tapering to the extremity, it is called a *tap-root*; when the root is fleshy and composed of lobes, as in the dahlia (Fig. 17), they are called *tubercules*, and the root *tuberous*. They are distinguished by the absence of buds from different forms of the under-ground stem, such as corms, tubers, and rhizomes, which are still called roots by most people. But some plants, as the plum, white thorn, moutan pæony, and others, have the power of developing adventitious buds upon the roots, which may then be advantageously employed in propagation.

Fig. 16.



Meadow-grass—Fibrous Root.

Fig. 17.



Dahlia—Tuberous Root.

root is branching, and divided into a number of long slender fibres (as in Fig. 16), it is

III.—THE STEM.

The stem is the axis that develops itself in an upward and opposite direction to that taken by the root. To the naked eye, it at first appears simply a conical projection, but

when magnified it is found to consist of several small lobes, *p* (Fig. 11), surrounding a growing point. These lobes afterwards expand into leaves; but in the centre of these leaves there is still a growing point, and as this pushes upwards, the rudiments of more leaves are formed and become successively developed.

There are three principal sorts of stems—namely, *Exogenous*, *Endogenous*, and *Acrogenous*.

Stems are called exogenous when they increase by the addition of layers to the outside of the wood, as in the apple, pear, and oak; endogenous, when they increase by additions at the centre, as in palms; and acrogenous, when they are formed by the union of the bases of leaves, and by additions to the point of the axis, as in tree ferns.

Exogenous Stems.—In the centre of the tender shoot or axis of these is the *pith* or *medulla*, which is entirely composed of cellular tissue. It is surrounded by a sheath of vascular and woody tissue, called the *medullary sheath*, and from this all leaves, buds, and branches take their rise. A branch of a tree may be of large dimensions, and very ponderous, but its origin may be traced to the tender herbaceous substance which has just been mentioned, and of which the branch is merely a prolongation.

The *wood*, *a b* (Fig. 18), is the part of the

annual layers, the age of trees can, in most cases, be determined with a considerable degree of accuracy. The stems of exogens increasing by the addition of layers to the outside of the wood, it is evident that the external one is the youngest; and this is called the *albumnum*.

The *albumnum*, *b*, is always softer than the *heartwood*, *a*, or that which is oldest and nearest the centre of the tree; its colour, also, is generally lighter. It is principally through the *albumnum* that the ascending sap is conveyed to the leaves.

The heartwood performs no important functions, except by constituting the columns on which the whole weight of the branches and other parts of the tree is supported. Indeed, as in the case of hollow trees, it is frequently altogether absent.

The *bark*, *c d*, is the external coating of the stem. In a very early stage of growth, it is scarcely distinguishable from the wood; but, somewhat later, on making a horizontal section of the young growth in spring, a thin layer of organizable matter, called the *cam-bium*, forms a circle, separating the two. This layer is the future *albumnum* and *liber*. The bark is found to consist of two principal parts, the *outer bark*, or *cortical integument*, and the *inner bark*, or *liber*.

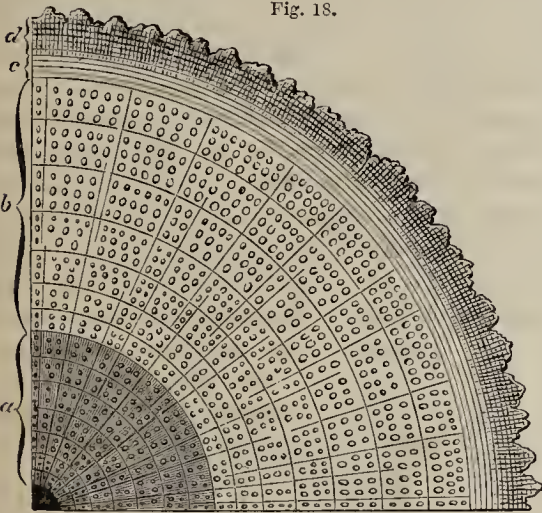
The *liber*, *c*, is next the wood; it consists of cellular, laticiferous, and woody tissues, and is composed of numerous thin layers, the youngest being always nearest the *albumnum*. The principal office of the *liber* is to carry downwards the sap, after it has been elaborated in the leaves.

The outer bark, *d*, is a tough substance which serves to protect the internal tissues. It consists of several layers; and, up to a certain age, it expands as the stem increases; but as new layers are formed, the old die, becoming dry, and often corky, forming those rugged fissures which we observe on the surface of old trees. Sometimes the old bark separates from the younger portion, and falls off.

The *medullary rays*, commonly known as the silver-grain of wood, form thin plates, which radiate from the centre towards the bark. They consist of cellular tissue, and form a connection between the centre and the circumference, conveying elaborated sap to the interior of the stem.

Endogenous Stems.—Such are those of palms, the sugar caue, bamboo, asparagus,

Fig. 18.

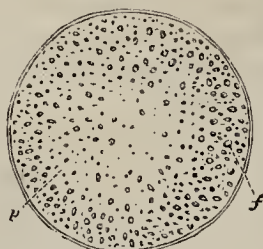


Transverse Section of Exogenous Stem.

stem which is situated between the medullary sheath and the bark. It is composed of concentric layers, each resulting from one year's growth, and of the medullary rays connecting the bark and the pith. By counting these

wheat, grasses, &c. Stems of this sort (Fig. 19) have no distinct concentric layers or medullary rays. The

Fig. 19.



Palm—Horizontal Section of Stem.

youngest formation takes place towards the centre, instead of at the circumference, as in exogens, and the pith, *p*, does not occupy the centre, but is interposed between bundles of woody and vascular tissue, *f*. These descend from the leaves, and, curving inwards, pass down near the middle of the stem for some distance, as in Fig. 20; and then taking an outward course, terminate at the circumference. The older formations, being thus continually pressed outwards, become harder and more compact than those in the interior. The stems of endogens have no true bark, but are covered with a cortical integument, similar to that of exogens.

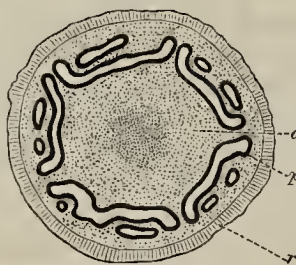
Fig. 20.



Palm—Longitudinal Section of Stem.

Acrogenous Stems.—These do not attain any considerable dimensions except in tree ferns. In these they are formed by the union of the petioles of leaves arranged round a common axis, and are of nearly equal diameter throughout their length, often 50 or 60 feet, bearing, at their summit, a tuft of leaves. The surface is covered with a hard rind, formed of the bases of the leaves, and marked by scars, caused by the falling off of these as growth proceeds.

Fig. 21.

Fern (*Cyathea*)—Transverse Section of Stem.

Internally the stem consists of cellular tissue, *c* (Fig. 21) occupying the whole of the centre of the trunk; and of hard sinuous plates of elongated tissue, *p*, disposed towards the circumference, either so as to form a continuous tube, or, with openings

between them, which are filled with cellular tissue, connecting that in the centre with a zone of the same tissue lying between the wood and the rind, *r*. In the interior of these woody plates, annular and dotted ducts are found. The thickening of the base of the stem of tree ferns arises from the development of adventitious roots. Acrogens have no flowers, but are reproduced by cellular bodies, called spores.

Subsequent remarks only apply to endogens and exogens.

Stems often exist underground in the form of *bulbs*, *corns*, *tubers*, and *rhizomes*, and above ground, as *runners*, and *suckers*.

The *bulb* (Figs. 22 and 23) is formed upon

Fig. 22.



Lily—Scaly Bulb.

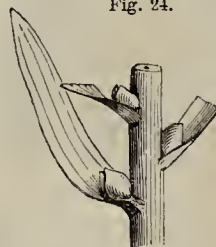
Fig. 23.



Leek—Tunicated Bulb.

or beneath the surface of the ground. It is composed of fleshy scales surrounding a stem, and roots proceed from its base. The scales are either imbricated, as in the lily (Fig. 22), when the bulb is called *scaly*, or they form continuous coatings, one within the other, as in the leek (Fig. 23), when it is called *tunicated*. In some bulbs, as the garlic and shallot, others are formed in the axils of the scales of the original bulb, the substance of which is thus eventually exhausted. These are called *cloves*. Bulbs differ but little from leaf-buds; indeed the latter in some cases,

Fig. 24.



Bulb-bearing Lily—Portion of Stem.

as in *Lilium bulbiferum* (Fig. 24), become metamorphosed into true bulbs.

The *corm* is a solid, fleshy mass, bearing a bud upon its surface, and having much of the general appearance of the bulb, with which it is frequently confounded. The so-called bulbs of the crocus and colchicum (Fig. 25) are *corns*.

The *tuber* is an enlargement of an underground shoot, bearing buds upon its surface, by means of which the plant may be propagated, and generally containing a large amount of starch. The potato and Jerusalem artichoke afford familiar examples of tubers.

The *rhizome* (Figs. 26 and 27) is a stem, creeping upon or beneath the surface of the ground, emitting roots from its under side, and bearing one or several buds upon its surface. These, on becoming stems, may either effect the further prolongation of the original rhizome; or they may be separated from the parent plant, and constitute fresh individuals. These, in their



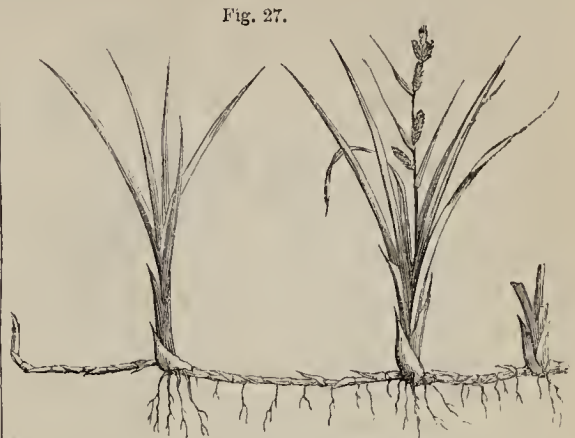
Colchicum—Corm.



Iris—Rhizome.

turn, may give rise to other rhizomes, and consequently to a still further increase in the number of plants, which may thus be situated

at a considerable distance from their common parent. The iris (Fig. 26), carex (Fig. 27),



Carex—Rhizome.

and the couch-grass (*Triticum repens*), afford examples of rhizomes.

The *runner* is a stem proceeding along the surface of the soil, and emitting roots and leaves at its extremity, where it forms a plant, from which other runners take their origin. The strawberry is a well-known example of a plant producing runners.

The *sucker* is a branch proceeding from the stem at or beneath the surface of the ground, into which it soon puts forth adventitious roots.

IV.—BUDS.

Buds are developed at the extremity of a shoot, and in the angle between the leaf and the stem or shoot, that is to say, in what is called the axil of the leaf. They are round, oval, or conical, and are composed of imbricated scales. The outer-



Sloe—Spines.

most of these are hardest and thickest; sometimes they are covered with a gummy or resinous substance, and their inside is generally downy. They inclose a minute growing point, which is in connection with the wood and tissue of the stem. It usually elongates and forms

a shoot having leaves, in whose axils other buds are formed; but sometimes it hardens and forms a *spine*, as in *Prunus spinosa* (Fig. 28),

and is either naked or occasionally furnished with buds near the base; and which, under certain circumstances, become developed into shoots or fruit spurs. Spines occur on the pear, plum, gooseberry, and berry; they must not, however, be confounded with prickles, such as those of the rose (Fig. 29), which are merely composed of hardened cellular tissue, and have no connection with the medullary sheath.



Rose—Stem with Prickles.

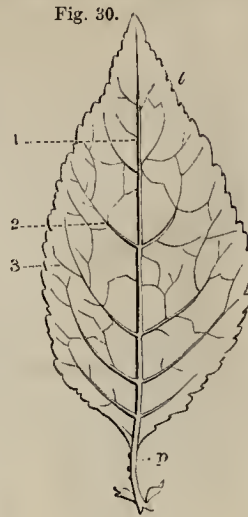
The scales of buds are leaves in an imperfect state. The outside ones generally die off; those nearer the centre remain comparatively green; and those next the rudimentary leaves, which surround the growing point, are in many cases scarcely distinguishable from these leaves.

V.—LEAVES.

Leaves consist of cellular tissue, interposed among a network of fibro-vascular tissue; originating in exogens from the medullary sheath and liber, and in endogens from the fibro-vascular tissue in the interior of the stem. The vessels on the upper side of the leaf are in connection with the alburnum, from which the ascending sap flows into them; and the vessels on the under side communicate with those of the liber and convey to it the descending elaborated sap. Leaves are covered with a cuticle and an epidermis, in which the stomates are particularly numerous, and which varies in thickness according to the locality in which the species naturally grows. Plants inhabiting moist shady places, where evaporation takes place with difficulty, have a thin epidermis, with numerous or large stomates, to allow of perspiration being carried on with greater freedom; those which, on the contrary, grow in hot dry situations, have a thick epidermis, and small or few stomates, in order to prevent too rapid evaporation from the surface of the leaves.

A leaf is composed, in most cases, of two principal parts, the *lamina*, *l* (Fig. 30), or

that which is usually called the *blade*, and the *petiole* or *leaf-stalk*, *p*. Sometimes, in addition to these, are attached to the base of the petiole appendages called *stipules*.



Cherry—Leaf.

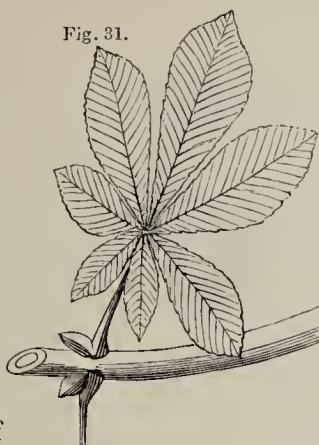
The *Petiole* is that portion of the leaf which forms a connection between the blade and the stem. It is composed of fibro-vascular bundles and cellular tissue, and results from the former remaining undivided for some distance before expanding to form the blade. Sometimes these bundles ramify at the point where they issue from the stem, and consequently there is no petiole; the leaf is then called *sessile*. In form the petiole is sometimes perfectly cylindrical, frequently flattened or channelled on its upper side; and it occasionally forms a sheath, surrounding more or less completely the shoot from which it springs.

The Blade.—In some leaves, such as those of pinus, the bundle of fibro-vascular tissue remains undivided throughout its length, so that the whole leaf preserves the form of a petiole. Generally, however, the bundle becomes divided into several ramifications termed *ribs* or *nervures*, forming at the end of the petiole a flat expansion, which is called the blade.

The nervures vary greatly in the direction which they take in the leaves of different species of plants. In many cases the petiole continues in a direct line to the end or *apex* of the leaf, constituting one large nervure, called the *midrib* (1, Fig. 30), and dividing as it goes into several other nervures, termed *secondary nervures* (2), which extend towards the margin of the leaf, and divide in their course into others called *tertiary nervures* (3); and these again subdivide into numerous small veins, which anastomose and form a fine network, the intervals of which are filled up with cellular tissue. In other cases several nervures proceed from the end of the petiole like the radii of a circle. In endogens, however, the secondary nervures do not usually divide, but run either parallel with the midrib, as in grasses, or at right angles to it, as in the banana.

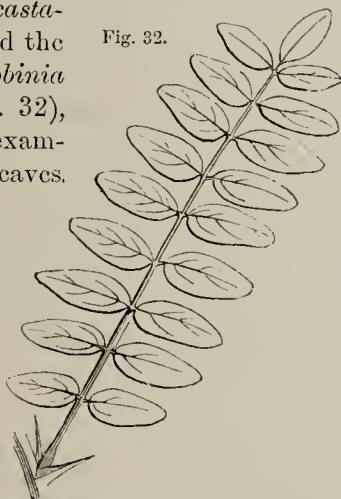
Leaves exhibit numerous modifications of form, according to which they are characterized as roundish, oval, lanceolate, heart-shaped, &c. The blade may consist of only one piece, as in the plum and cherry, when the leaf is called *simple*; or it may be composed of several distinct portions borne on a common petiole, in which case the leaf is said to be *compound*, and the portions of which it is composed are termed *leaflets*. The horse-chestnut (*Æsculus Hippocastanum*, Fig. 31), and the locust-tree (*Robinia Pseudacacia*, Fig. 32), afford familiar examples of compound leaves.

Fig. 31.



Horse-chestnut—Compound Leaf.

Fig. 32.



Robinia—Compound Leaf.

Fig. 33.



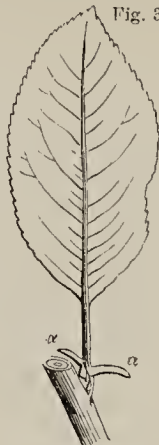
Oleander—Entire Leaves.

Both simple leaves, and the leaflets of those which are compound, are frequently divided more or less deeply. In some leaves (as in Fig. 33) these divisions do not exist, and the leaf is then said to be *entire*; but in others the margin exhibits toothings of various kinds; and in others again there are deeper divisions, or *lobes*, extending to a greater or less distance towards the midrib.

Stipules, *a*, *a* (Fig. 34), are small appendages, situated on each side of the base of the petiole; and similar appendages also occur, in many cases, at the bases of the leaflets in compound leaves, in which case they are called *stipels*. They vary greatly in appearance; sometimes they look like small leaves, and are of the

same colour as the leaves themselves; sometimes they are like scales; and sometimes they have the appearance of a thin, colourless, nearly transparent membrane. Frequently, as in the rose, they are united to the petiole at one side, and nearly throughout their length; occasionally they form a sort of sheath round the stem, remaining separate or uniting by their margins; and often they are only united to the petiole by their base. Stipules are, to a certain extent, capable of performing the functions of leaves, but their

Fig. 34.



Pear tree—leaf.

precise use is, uncertain. Like leaves they, in some cases, develop buds in their axils.

Acted upon by heat and light, leaves draw nourishment from the soil by the roots. The sap, so obtained, after ascending through the stem, chiefly by the alburnum, passes into the upper side of the leaf, there undergoes the action of light, parts with a portion of its moisture, and becomes otherwise greatly changed in its nature. It then descends by the under side of the leaf into the liber, and, continuing its downward course to the very extremities of the roots, is appropriated, as it goes, for the nourishment and growth of the plant. Moreover, leaves have the power of absorbing gases, and perhaps moisture, from the atmosphere; and of exhaling, in a gaseous form, substances not required by the plant. Thus leaves at once perform the functions of digestion and respiration, and are to the plant what the lungs and stomach are to animals, and scarcely less essential to life.

“In the course of time a leaf becomes incapable of performing its functions; its passages and surface are choked up by the deposit of impurities; there is no longer a free communication between its parenchyma and that of the rind, or between its veins and the wood and liber; or the air and its interior. It changes colour, ceases to decompose carbonic acid, absorbs oxygen instead, gets into a morbid condition, and dies—it is then thrown off.”—(Lindley's *Theory and Practice of Horticulture*, p. 79.)

VI.—THE FLOWER.

The flower is defined as being “a terminal

bud, inclosing the organs of reproduction by seed. By the ancients, the term flower was restricted to what is now called the corolla; but Linnaeus wisely extended its application to the union of all the organs which contribute to the process of fecundation. The flower, therefore, as now understood, comprehends the *calyx*, the *corolla*, the *stamens*, and the *pistil*, of which the last two only are indispensable. The calyx and corolla may be wanting, and a flower will nevertheless exist; but, if neither stamens nor pistil, nor their rudiments, are to be found, no assemblage of leaves, whatever may be their form or colour, or how much soever they may resemble the calyx and corolla, can constitute a flower.”—(Lindley's *Introduction to Botany*.)

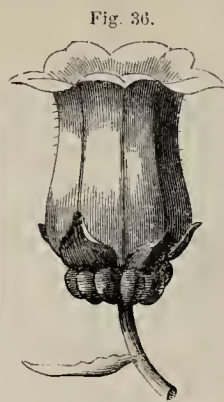
As the flower is at first a bud, it proceeds from the axils of leaves. It is supported by a stalk, called a *peduncle*; but this stalk is frequently ramified, and in that case, the subdivisions in immediate connection with the flower, are termed *pedicels*.

Of the parts above-mentioned, the calyx and corolla constitute what are called the *floral envelopes*, which surround the reproductive organs.

“The **CALYX** is the external integument of the flower, consisting of several verticillate leaves, either united by their margins or distinct, usually of a green colour, and of a ruder and less delicate texture than the corolla.”—(*Introd. to Botany*.) The divisions of the calyx, *s s s* (Fig. 35), are called *sepals*. When it is not divided, it is termed *monophyllous*, the sepals in this case uniting, so as to form a cup or tube. The calyx is generally green, partaking much of the character of leaves; but occasionally it is coloured, and scarcely distinguishable from the petals, as in tulips, in which the three sepals are arranged and brilliantly coloured, like the petals.

THE COROLLA.—This is situated within the calyx, and forms the envelope next to the stamens. Its divisions are called *petals*, *p p p* (Fig. 35), and these alternate with the divisions of the calyx. The divisions of the corolla are sometimes united by their margins, in the same manner as those of the calyx; they then form a tube, as in Fig. 36, and the

corolla is called *monopetalous*. The colour of the corolla is rarely green. “The corolla, and



Campanula Flower.

all other parts of the flower not coloured green by the influence of light, absorb oxygen and exhale carbonic acid. The presence of a mass of flowers more or less brilliantly coloured has, therefore, an action on the atmosphere quite the reverse of the salutary one exercised by a mass of green leaves. This effect is frequently complicated by the exhalation of the essential oils and other odoriferous principles, so often concentrated in this part of a plant.”—(A. De Jussieu.)

The **STAMENS** (Fig. 37), or male organs of the flower, are situated within the corolla. Their number is variable. A stamen consists of three parts, the *filament*, the *anther*, and the *pollen*.

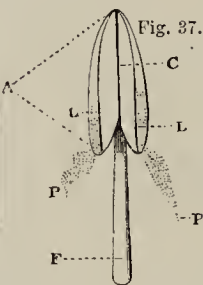
The *filament*, *F*, is that part of the stamen which supports the anther. It is similar in structure to the petiole of a leaf, and is the only part of the stamen which is not essential. When it is altogether absent, the anther is called *sessile*.

The *anther*, *A*, is attached to the extremity of the filament. It is in general composed of two lobes, *L L*, united together by a continuation of the filament, called the *connective*, *c*. These lobes contain a fine dust, which is the pollen.

The *pollen*, *P*, is contained in the lobes of the anther, and consists of a number of fine hollow grains of various shapes, spherical, oblong, triangular, or polygonal. Their size is also variable. The grains of pollen contain minute globules of oil and starch; other bodies have also been found in them.

The **PISTIL** (Fig. 38), is the female organ of the flower, in the centre of which it is always situated. It is composed of three parts—the *ovary*, the *style*, and the *stigma*.

The *ovary*, *O*, is a hollow case, varying in



Gillyflower - Stamen.



Strawberry Flower.



Primrose - Pistil.

form, but generally spheroidal or ovate. It is situated at the base of the pistil, contains one or more cells, and incloses the *ovules*, which, after impregnation, become the seeds, itself forming the fruit.

The *style*.—Between the ovary and the stigma, there is usually a slender column supporting the latter, and which is called the style. This part, *s*, is not absolutely essential; it is frequently absent, in which case the stigma is immediately attached to the ovary. The style is generally smooth, but is sometimes provided with hairs, apparently for the purpose of collecting the pollen, and which are, therefore, called *collectors*.

The *stigma*, *st*, is generally situated at the upper extremity of the style. Its surface is destitute of epidermis, and is, in consequence, humid or papillose. The centre consists of lax tissue, so that the particles of pollen coming in contact with the moist surface of the stigma, can fertilize the ovules through the medium of the conducting tissue of the style.

The *ovule*, which term signifies a small egg, is the rudiment of the seed. One or many of these ovules are formed within the ovary or seed vessel. Without the influence of the pollen, the ovules sometimes grow to a considerable size, assuming the appearance of a perfect seed; but if fertilization has not taken place, it cannot in reality be a seed, for in that case it contains no reproductive principle.

Most flowers contain both the male and female organs above described, in which case they are called *hermaphrodite*; but there are others in which the stamens or male organs only are present, these are called *male flowers*; others again have only the pistil or female organ, these are called *female flowers*.

In some plants, both the male and the female flowers occur on the same individual. Such plants are called *monoecious*; among these are the filbert (Fig. 39), in which ♂ is the male, and ♀ the female flower; and the oak.

In other plants, the male and female flowers

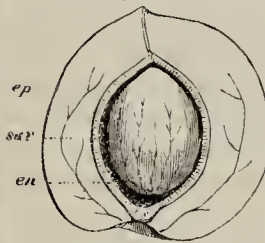
are on different individuals. Such plants are called *dioecious*; and amongst them are included willows and poplars.

VII.—THE FRUIT.

After fertilization has taken place, the floral envelopes and the sexual organs usually drop off, the ovary alone remaining; this swells, and, when matured, becomes the fruit, containing the seed. It consists of two principal parts—the *pericarp* and the *seed*.

The *PERICARP* is the external part of the fruit; and whatever does not constitute a part of the seed is a part of the pericarp. It is the edible portion of most kinds of fruits. Its texture, however, varies much; in apples, pears, &c., it is fleshy; in nuts, it is hard and woody, constituting the shell; and in pease and beans it is coriaceous, and constitutes the husk, the edible part in these cases being the seed.

Fig. 40.



Apricot—Ripe Fruit, vertical section.

The pericarp consists of three parts—the *epicarp*, *sarcocarp*, and *endocarp*.

The *epicarp* (*ep*, Fig. 40), is the external covering, and is what is usually called the skin of the fruit.

The *sarcocarp* (*sar*) lies between the epicarp and the endocarp, and is the fleshy portion of such fruits as the apple, pear, and peach.

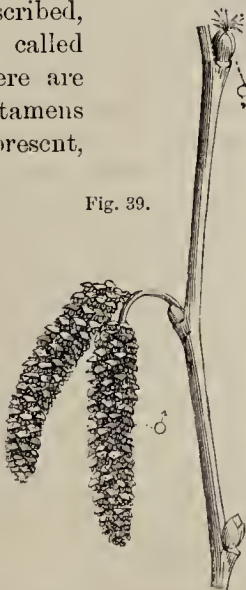
The *endocarp* (*en*) forms the inner coating. It is sometimes membranous, sometimes hard and bony, as in the stone of a peach.

In a cherry, peach, or apricot, the skin is the epicarp; the flesh or edible portion, the sarcocarp; and the stone, the endocarp. Again, in the apple, the skin is the epicarp; the flesh, the sarcocarp; and the horny substance immediately surrounding the seeds, the endocarp.

The *SEED* generally consists of three principal parts—the *testa*, the *albumen*, and the *embryo*.

The *testa* is formed of two or more integuments closely united. The outer one is of various colours in different plants, and even in varieties of the same species; for example, in the kidney bean it is, in some varieties, entirely white, in others, jet black or speckled. Its surface is either smooth or rough; and its consistence is either membranous, coriaceous, crustaceous, fleshy, or woody.

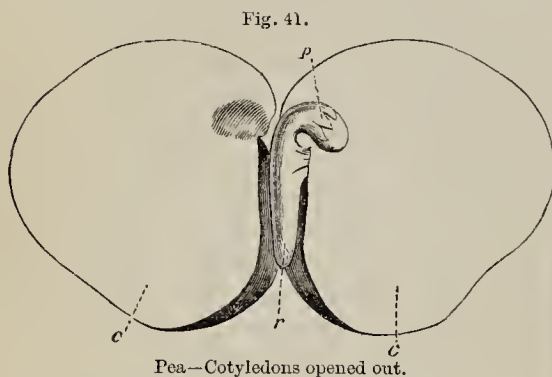
Fig. 39.



Hazel Nut—Monoecious Flower.

The *albumen* is situated between the testa and the embryo. It is destined to feed the germinating embryo until the latter can develop organs to draw nourishment from external sources.

The *embryo* is the most essential part of the seed, for it is the rudiment of the future plant. It consists of three parts: the *radicle* *r* (Fig. 41), the *plumule* *p*, and one or two



cotyledons c c. The radicle is the origin of the root; the plumule gives rise to the stem; and the cotyledons contribute to the growth of the germinating plant, and perform, to some extent, the office of leaves, till such time as these can be developed from newly formed tissue at the apex, or growing point, of the plumule.

CHAPTER II.

GERMINATION.

A seed contains, when perfect, the rudiments of a future plant, as has been already stated. This, in many cases, may continue dormant for one or many years, unless brought under circumstances favourable to its vegetation. These circumstances are essentially heat and moisture—stimulated by these, growth commences, and its first process is termed *germination*. The seed being swelled by moisture, and its integuments softened by the same agency, the radicle is enabled to push out, and it strikes downwards; whilst the plumule takes an upward direction, and the cotyledons begin to expand. These sometimes remain underground, as in the common bean; or they rise above it, as in the turnip, radish, and most plants. By exposure to the light they acquire a green colour, and

perform the functions of leaves. They supply the young plant with nourishment from their substance till roots and leaves are formed, and till the plant can feed itself. The cotyledons then drop, and germination is complete. A seed cannot germinate without a certain amount of moisture, air, and heat. "Moisture softens the integuments of the seed, and relaxes the tissue of the embryo itself; atmospheric air supplies oxygen, where-with carbonic acid may be generated by the seed, and also nitrogen, which is found experimentally to disappear in all cases of germination; while a temperature above 32° excites the vitality of the embryo, and enables it to take advantage of the agents in contact with it.

"The amount of moisture which a seed can bear when germinating, depends upon its specific nature. When plants naturally live in water, it seems that total immersion is requisite, in order to furnish the seed with the amount of water it requires. Thus, all attempts at introducing the Canadian rice plant (*Zizania aquatica*), failed until the seeds were plunged in vials of water; and our own *Glyceria fluitans* exhibits another example of the same fact. But to land plants, water, in a fluid state, is mischievous, if not fatal; for with them, if the act of germination should take place under water, the seeds almost immediately afterwards die and rot. It is in the state of vapour that water is most safely applied, and hence dampness is what their seeds require, rather than wet; and it is found by experience that even a saturated atmosphere is unsuited to germination, unless the vitality of seeds is extremely active. Gardeners therefore take care, in raising old and feeble seeds, to trust wholly to the vapour suspended in a damp atmosphere, and to avoid the moisture that may be entangled among soil.

"Free access to the atmosphere is a condition in the absence of which germination becomes impossible; for although there is reason to believe that, in a suitable temperature, seeds can decompose the water with which they are in contact, and so supply themselves with oxygen, yet the earliest act of growth must first be excited, and for that nitrogen seems indispensable; nor can their power of decomposing water be afterwards maintained, unless there is still present that nitrogen, which they have no means of obtaining under ordinary circumstances, except from the

atmosphere. This explains the reason why seeds buried in stiff clay, or at considerable depths below the surface, although damp, refuse to germinate until they are accidentally brought into contact with air; and it furnishes a solution of the singular but well-known fact, of certain crops suddenly appearing where they had not been previously known to exist, provided the soil is wholly broken up to a considerable depth; as, for instance, when wild mustard covers the face of recent railway cuttings. The true principle of seed-sowing is, therefore, never to bury seeds deeper than is indispensable to the preservation of dampness round them, or to their protection from vermin. Exposure to light is generally regarded as injurious to germinating seeds; and it is a common opinion that they are covered as much with a view to keeping them in darkness as for any other reason. But experiments by no means confirm these statements; on the contrary, if seeds are deposited upon damp soil, and are then covered with a plate of glass closely pressed down upon them, they germinate as well as if in darkness, though, perhaps, not so quickly. The covering of seeds with earth is, therefore, to be regarded rather as a method for preserving around them the necessary moisture, than as a means of guarding them from light.

"The temperature at which air and moisture will act upon the vitality of an embryo varies extremely. The only fixed rule upon the subject is, that for all cultivable plants it must be somewhere between 32° and below 100°. Below 32° none will germinate; above 100°, if that temperature is prolonged, all perish. Several cases, indeed, are upon record of seeds having been exposed for a few minutes to the heat of boiling water, without sustaining injury; but they could not have supported such a temperature much longer; and those which can bear it at all are invariably furnished with hard bony coats. Perhaps 40° to 50° may be taken as a favourable temperature for the germination of ordinary agricultural crops; 60° to 70° for the more tender kinds, such as maize; and 80° for tropical annuals, like tobacco. As a general rule, it may be said that all seeds will germinate more readily in a temperature above what they are accustomed to than below it."—(Professor Lindley in *Morton's Cycl. of Agriculture*.)

With respect to the chemical changes which take place in germination, we extract the following from an excellent article in the same work by Professor Way:—

"Confining our attention now to the chemical character of the seeds, and to the chemical changes which they undergo during germination, we learn, first, that they consist of one or more azotized or nitrogenous bodies, of the nature of albumen or caseine, of starch, gum, and sugar, and oily and fatty matters, together with a certain quantity of alkaline and earthy salts.

"The relative proportion of all these ingredients is as variable as the different varieties of seeds are numerous, but they are more or less to be discovered in every seed. It is natural to suppose that during the physiological changes occurring in germination, important modifications of a chemical nature should also result. If a few grains of wheat, or any other seed, are moistened and left in a warm place, we soon observe a remarkable change. The seed swells considerably, and at last the surrounding envelope is burst, and the rudiments of the roots and stem of the future plant make their appearance. Supposing, now, that we had taken the trouble to weigh a certain number of the original seeds after carefully drying them, and, further, when the germination had proceeded to some length, we had also dried and weighed the sprouted seed, it would be found that the latter weighed considerably less than before the experiment; in other words, that, during germination, solid matters other than water had been removed from the seed.

"To the investigations of M. de Saussure, on the chemistry of vegetation, we are indebted for the larger part of our information on this, as on other similar subjects. Following out the observation previously made by Rollo, he ascertained, by careful experiments, that this loss of weight is principally due to the separation of carbon, in the form of carbonic acid. Saussure placed seeds, properly moistened, in a portion of air confined in a glass jar, over mercury, and exposed to the necessary degree of warmth. No change of the volume of confined air was observed, but upon examination it was found that a portion of its oxygen had disappeared, and had been replaced by carbonic acid gas, which, by a well-known chemical law, necessarily occupied the same space. He found also that a seed

would germinate readily in pure oxygen gas, but not in nitrogen, hydrogen, or carbonic acid gases.

"It is clear, therefore, that germination is, to a certain extent, a process of combustion, requiring for its exhibition a supply of oxygen, which, in natural circumstances, is obtained from the air.

"The quantity of oxygen required for the germinating process is not the same with all seeds, which probably accounts for the fact that some seeds are found to vegetate at greater depths in the soil than others. The necessity of air for the sprouting of seeds, explains also the curious circumstance, often brought under the notice of the practical farmer, that a more than usually deep ploughing, or the turning up of the subsoil in trenching or cutting of drains, will often produce a luxuriant crop of weeds, which, to all appearance, had been extirpated by his previous efforts. The seeds of these plants, lying deep in the soil, and out of reach of the aerating influences of the plough and other implements, may remain inert for a series of years, only to be called into life upon the approach of the necessary conditions of air and moisture

"In retentive soils the depth to which the air can penetrate is evidently less than in porous open lands; and drainage of such stiff soils must, by inducing permeability to air, of course deepen the effective seed-bed. The loss of carbon, in the form of carbonic acid, is not, however, the only change which the seed undergoes during germination—hydrogen and nitrogen are also separated; the former partly by combination with oxygen, as water, and partly in the form of ammonia by uniting with the nitrogen. As before said, the nitrogen of the air seems to have no part in these transformations, and the action is limited to the changes occurring either amongst the elements of the seed itself, or these and the oxygen of the air. In addition to the changes before specified, we find, in the sprouting of a seed, the production of a vegetable acid (either the acetic or lactic acid), and a modification of the albuminous matters, which enables it subsequently to convert the starch of the seed into sugar. The formation of this modified albuminous substance (diastase), is the great object aimed at in the process of malting.

"There are some seeds which germinate under water, and it might be thought that this circumstance was opposed to the theory of the

necessity of air; but, in fact, no natural water is free from atmospheric air, and the seeds of aquatic plants germinate just as fish live in water, even when it is covered with ice, by virtue of the oxygen dissolved in it. Saussure boiled water for a sufficiently long time to expel the air, and could not succeed subsequently in causing seeds to germinate in it.

"It is difficult to see the precise object of some of the chemical changes accompanying germination. The formation of carbonic acid is attended, of course, with the production of a certain amount of heat, so that the requisite temperature for the commencement of the process having been attained, it is carried on and completed, in a great measure, by internal causes. It may be that nature, in this way, has guarded against any interruption to the vegetative forces from local and accidental changes of temperature. The separation of nitrogen, in the form of ammonia or otherwise, may be merely incidental, and connected only with the necessary modifications of the albuminous matters of the seed, giving rise to the substance which has received the name of diastase.

"The materials which are accumulated in the seeds are evidently designed, as was before stated, to furnish the first food to the young plant; in many seeds starch forms the staple and most important ingredient of this food; but starch is insoluble in cold water, and could not, without aid, acquire the necessary degree of mobility to be transferred from the seed to the growing part of the vegetable. Modified albuminous matter, however, or diastase, has the property of converting insoluble starch into soluble sugar, and thus the difficulty is successfully overcome.

"The description now given of the changes occurring during germination only applies to its earliest stages; so soon as the green parts of the plant are formed above ground the whole state of things is reversed; instead of giving off carbonic acid, the plant now needs this gas for its sustenance, and is endowed with the extraordinary power, in the presence of light, of decomposing it and appropriating its carbon; and ammonia, in the same way, becomes necessary to its well-being.

"From what we have lately learned of the absorptive properties of the soil for both these gases, it is possible that their production during germination, and consequent retention at short distances from the seed, is an express

provision of nature for a supply of food, so soon as the roots shall have made their first growth.

"The action of light in germination has been a matter of much difference of opinion; on the one hand, it has been contended that the practice of burying the seed was an evidence of the injurious tendency of light; on the other, that the absence of all light is the reason that seeds placed at a great depth in the soil fail to vegetate. For the latter of these facts we have already offered a sufficient explanation; and without entering, in this place, further into the subject, it may be stated that, in all probability, the only influence which light exercises on germination is of an incidental and unnecessary kind.

"The degree of warmth requisite for the commencement of vegetation, on different seeds, has not been satisfactorily ascertained. In northern countries, and even in our own temperate climate, the seeds of plants exhibit vitality at a temperature very little above the freezing point of water. Below 32° Fah., however, it would seem that germination cannot take place, no doubt because the necessary circulation of the fluids is, at that temperature, physically impossible. It has already been mentioned that germination cannot take place in nitrogen, or carbonic acid gases. It would not appear that the two former of these gases are actually prejudicial to the vegetative process, but that it fails to occur in them from the absence of oxygen. M. de Saussure, however, found that carbonic acid, which is itself a product of the germinating process, exercises a positively antagonistic influence; and the rapidity of germination is sensibly accelerated by anything that will remove this gas as it is formed. Thus, slacked lime, placed in the neighbourhood of a seed vegetating in a limited quantity of air, hastens the process considerably. We have reason to believe that this effect is produced, as perfectly as it could be in a properly cultivated soil, in part by the absorptive property of the soil for the gas in question, and still more by its constant diffusion into the air, with which the pores of the soil are filled. Ammonia and its carbonate, when in too concentrated a form in the soil, are also capable of arresting or entirely destroying the vegetative power of seeds. This explains the injurious results which are experienced when the seeds of wheat or turnips are placed too near to guano."

CHAPTER III.

THE FOOD OF PLANTS.

The elements which, on analysis, are found in plants must be the constituents of their food. Those which have been so found are included in the following table, together with their symbols and equivalents, which may be useful to the gardener when reference is made to the analysis of soils, manures, &c.:

Name.	Symbol.	Equivalent.
Aluminum,	Al.	13·7
Bromine,	Br.	80·
Calcium,	Ca.	20·
Carbon,	C.	6·12
Chlorine,	Cl.	35·5
Hydrogen,	H.	1·
Iodine,	I.	127·1
Iron,	Fe.	28·
Magnesium,	Mg.	12·2
Manganese,	Mn.	27·6
Nitrogen,	N.	14·15
Oxygen,	O.	8·
Phosphorus,	P.	32·
Potassium,	K.	39·2
Silicon,	Si.	21·3
Sodium,	Na.	23·
Sulphur,	S.	16·

The principal elements in the composition and food of plants are, however, these four—carbon, oxygen, hydrogen, and nitrogen. The first three form cellulose or cellular fibre (C_{21}, H_{21}, O_{31}), starch (C_{12}, H_{10}, O_{10}), gum (C_{12}, H_{10}, O_{10}), sugar (cane sugar, C_{12}, H_{10}, O_{10} ; and grape sugar, C_{12}, H_{12}, O_{12}) and pectin, C_{23}, H_{21}, O_{21} , substances which constitute by far the greatest portion of all vegetables. It will be remarked that hydrogen and oxygen are present in all except pectin in the exact proportions necessary for the formation of water. With nitrogen, the same elements form vegetable fibrine, vegetable albumen, and vegetable caseine.

It is principally by the roots that nourishment is obtained, and, as these cannot absorb solids, it follows that the substances on which plants feed must exist in a liquid or gaseous state before they can be taken up by the roots; and it is exclusively in these two states that all the food of plants is absorbed. The food of plants is presented to the roots in a liquid state by the agency of water, which has the property of holding most solid substances in solution, and of absorbing a greater or less portion of all gases which are brought in contact with it. Water at 60° and 30 bar. will,

according to Dalton and Henry, absorb its own volume of carbonic acid and sulphuretted hydrogen, and, according to Thomson, 780 times its own bulk of ammonia.

Carbon, which exists pure in the diamond, and in the form of charcoal, is familiar to every one. Carbon, together with water, constitutes the principal bulk of vegetables; but it can only be assimilated by plants when it is combined with oxygen; or, in other words, before it can become the food of plants it must be turned into carbonic acid. With reference to this subject, Sir Humphrey Davy tried an experiment, which he details in his *Agricultural Chemistry*:—"Some impalpable powdered charcoal, procured by washing gunpowder, and dissipating the sulphur by heat, was placed in a vial containing pure water, in which a plant of peppermint was growing; the roots of the plant were pretty generally in contact with the charcoal. The experiment was made in May, 1805; the growth of the plant was very vigorous during a fortnight, when it was taken out of the vial. The roots were then cut through in different parts, but no carbonaceous matter could be discovered in them, nor were the smallest fibrils blackened by the charcoal, though this must have been the case had the charcoal been absorbed in the solid form."

Charcoal, which is frequently used as a manure, does not act as such by changing into carbonic acid, for it is one of the most indestructible substances known. Its effects are solely owing to the property which it has of retaining large quantities of various gases in its pores.

Saussure found that freshly-burned charcoal absorbed of

Ammonia,	90	times its own volume.
Hydrochloric acid,	85	" "
Sulphuretted hydrogen, ..	81	" "
Carbonic acid,	35	" "
Oxygen,	9.25	" "
Nitrogen,	7.5	" "
Hydrogen,	1.75	" "

Carbonic Acid.—As carbon constitutes with water the principal mass of vegetables, and cannot become their food except in the soluble form of carbonic acid, it follows that this gas must be of the greatest importance with respect to the nourishment of plants. Carbonic acid consists of one equivalent of carbon, united with two equivalents of oxygen. It is a colourless gas, with an acidulous taste, and

heavier than atmospheric air, its sp. gr. being 1.524. It prevents combustion and respiration, proving fatal to animal life, even when present in moderate quantity. Water, when recently boiled, dissolves its own volume of carbonic acid at 60° and 30 bar., but under a greater pressure much more will be absorbed. This gas is always present in the atmosphere, and also in spring water.

Carbonic acid is given off in large quantities by volcanoes, and is always produced by the combustion and decay of substances containing carbon, and by the respiration of all animals.

Combined with alkaline substances it gives rise to a class of salts called *carbonates*; one of which, carbonate of lime, or chalk, is very plentiful, and forms the principal portion of some soils.

"It is only under the influence of light that plants can decompose carbonic acid, fixing its carbon, and setting free its oxygen. During the night, on the contrary, they undergo a kind of slow combustion, oxygen being absorbed, and carbonic acid formed. But the balance in this curious alternation is vastly in favour of the process by which oxygen is sent into the atmosphere—for the whole carbon of a forest, for example, being derived from carbonic acid, an equivalent quantity of oxygen must have been liberated; and this consideration alone enables us to explain the fact, that, notwithstanding the enormous amount of oxygen withdrawn from the atmosphere by the respiration of animals, by combustion, by putrefaction, and by the action of vegetables during the night—in all of which processes the oxygen is converted into carbonic acid of equal volume—the proportion of oxygen in the atmosphere does not diminish, and that of carbonic acid does not increase.

"From these considerations it appears, that there must always exist a balance or fixed proportion between the existing amount of animal and that of vegetable life. Where animals abound, and where men carry on the usual operations of civilized life, there, carbonic acid must be largely formed; but this carbonic acid, in yielding its carbon to vegetation, yields also its oxygen to restore the purity of the air, and support again the respiration of men and animals. Again, the decay and putrefaction of both animals and vegetables yield carbonic acid and ammonia—the very substances which form the food of a new race of vegetables; and these again contribute

to the nourishment of new animals; so that, in this unceasing round of chemical changes, the death of one generation supplies the means of life to that which is to follow."—(Turner's *Chemistry*.)

Oxygen is always gaseous when uncombined, and without colour, taste, or smell; it is heavier than atmospheric air, its sp. gr. being 1.1026.

Oxygen is a constituent of the atmosphere, and enters largely into the composition of all plants. It has a powerful tendency to combine with most elementary substances forming either *oxides* or *acids*. The act of combining with it is termed *oxidation*.

Combustion is nothing but rapid oxidation; respiration the same thing, taking place with a less degree of intensity. Neither plants nor animals can live in an atmosphere deprived of oxygen.

Oxygen is absorbed in germination, and carbonic acid is given off; but when the plants begin to feed themselves, the reverse takes place; the carbonic acid taken up by the roots is decomposed by the action of light in the leaves, the carbon is appropriated by the plant, and the oxygen, or a part of it, is returned to the atmosphere. Plants liberate oxygen by the decomposition of water and carbonic acid; and the excess of oxygen thus obtained beyond the requirements of vegetation, is returned to the atmosphere.

Hydrogen is the lightest body in nature, its sp. gr. being 0.06896. It is colourless, tasteless, and inodorous, and will not support combustion or respiration; but an atmosphere composed of oxygen and hydrogen may be breathed.

When hydrogen is mixed with oxygen, and the mixture set on fire, a violent explosion takes place, and water is generated; and the same result takes place, though more slowly and without an explosion, when the two gases are mixed and exposed to light.

Hydrogen is found in plants in much less quantity than oxygen. The supply of this gas is obtained by the decomposition of water and also of ammonia. The fatty and volatile oils, so frequent in certain parts of plants, are always rich in hydrogen.

Nitrogen is a colourless, tasteless, inodorous gas, which enters into the composition of the atmosphere to the extent of 80 per cent. by volume. It is lighter than atmospheric air, its sp. gr. being 0.9722, and, like hydrogen, it will not support respiration or combustion.

Plants derive their nitrogen exclusively from ammonia and nitric acid; and though it has been supposed that they obtain nitrogen from the atmosphere, yet it is now generally admitted that the nitrogen of plants is assimilated from the two sources above-mentioned. "Estimated by its proportional weight, nitrogen forms only a very small part of plants; but it is never entirely absent from any part of them. Even when it does not absolutely enter into the composition of a particular part or organ, it is always to be found in the fluids which pervade it."—(*Liebig*.)

Ammonia is a colourless gas with a strong pungent smell, and composed of one equivalent of nitrogen and three equivalents of hydrogen. It has all the properties of an alkali, combining with acids, and completely neutralizing them. Ammonia is produced by the decay of all organic substances; it is, however, never present in the atmosphere in a free state, existing there either as a carbonate or nitrate, and is brought down as such by rain, which always contains more or less ammonia in one or other of these states. This gas is the principal source from which plants derive their nitrogen, and is, therefore, of the greatest importance. It has been already stated, that ammonia is absorbed in large quantity by water. The same property is also possessed by the soil, which abstracts it to some extent from the atmosphere. The action of an important class of manures is attributable to this substance being contained in them, or to its gradual formation during the process of decay.

Having now noticed the four great components of the food of plants, we shall proceed as briefly as possible with the other substances which enter into their composition, and which are scarcely less necessary to their growth.

When a plant is burned, the mineral substances which it has taken up from the soil remain as ashes. The composition of these varies in different species of plants, and even in different parts of the same plant; for instance, the tuber of the potato contains 86 per cent. of the salts of potash and soda, whilst the herb contains only 4 per cent. of these substances.

The following table, extracted, on account of its great value, from Morton's *Cyclopedia of Agriculture*, exhibits the results of the latest analyses of the ashes of plants:—

TABLE—Showing the Composition of the Ashes of Grasses, Tobacco, Hops, Vegetables, Forest and Fruit Trees, and Various Marine and Land Weeds.

NAME OF PLANTS, OR OF THEIR PARTS.	Ash in 100 parts.	Ash in plant naturally dried.	Potash.	Soda.	Magnesia.	Time.	Phosphoric Acid.	Sulphuric Acid.	Stalks.	Peroxide of Iron.	Chloride of Sodium.	Chloride of Potash.	Locality of Plant.	Analyst.	REMARKS.
White mustard (seeds),	4.15	—	9.80	9.18	11.0	20.81	36.60	5.29	3.29	1.43	0.33	—	Giessen.	James.	
Black mustard (seeds),	4.31	—	12.01	4.63	13.64	16.47	35.46	6.79	2.63	1.06	2.15	—	"	"	
Madia (<i>Madia sativa</i>) seed,	6.85	—	9.53	11.24	15.42	7.74	54.99	3.24	43.85	1.08	—	—	Scotland.	Souhay.	
Rye-grass seed,	—	—	4.97	1.43	5.51	19.24	19.59	8.25	29.77	2.17	—	—	"	Thomson.	
Meadow hay, mean of 4 analyses,	—	8.06	21.73	4.85	4.91	18.93	9.85	4.23	3.46	0.63	8.86	—	Germany.	Sprengel.	
Lucerne,	—	9.55	14.03	3.64	3.64	50.57	13.68	4.23	3.77	0.62	CL 3.3	—	Horsford.	Horsford.	
Red clover,	—	11.17	16.10	40.71	8.98	21.91	4.12	1.06	2.60	0.46	4.73	—	France.	Houssingault.	
Clover,	—	7.7	35.47	0.67	8.40	32.80	8.40	3.83	7.06	0.40	5.8	—	Scotland.	Thomson.	
Rye-grass,	—	5.89	8.03	2.17	4.01	6.50	12.51	—	64.57	0.36	—	—	"	"	
Common reed (<i>Arundo Phragmites</i>),	1.62	—	4.80	—	0.34	6.06	31.19	5.49	78.91	0.93	0.3	—	"	Fromberg.	
Esparsette, or Sainfoin,	—	—	6.75	20.33	8.57	31.01	26.10	1.68	1.10	2.28	2.18	—	Besan.	Buch.	
Asparagus,	—	—	28.07	3.96	4.44	18.04	19.74	7.84	13.69	5.78	CL 4.4	—	"	Levi.	
Sugar cane (stalks),	—	—	32.93	—	3.93	9.34	7.37	7.97	17.64	—	—	—	Damerara.	Stenhouse.	
" (whole plant),	—	—	16.03	0.35	16.34	10.10	6.14	8.30	44.17	—	8.76	—	Trinidad.	"	
" (young and transparent),	—	—	14.20	1.18	3.51	5.12	6.33	7.22	47.20	—	5.04	—	Berblot.	"	
Tobacco leaf,	—	—	9.56	0.27	5.51	12.21	7.98	8.53	51.84	—	8.47	—	Jamaica.	"	
"	—	—	29.08	2.26	7.22	30.35	2.74	3.75	—	6.04	0.91	—	Debreuzyn.	"	
"	—	—	30.67	—	8.57	27.12	1.88	8.27	—	4.15	5.95	—	"	"	
"	—	—	27.88	—	7.81	33.84	1.99	3.75	—	4.40	9.34	—	"	"	
"	—	—	18.20	—	15.73	32.06	2.12	5.91	—	4.68	11.41	—	Banat.	"	
"	—	—	8.20	—	13.93	46.08	1.90	4.65	—	4.17	3.22	—	Fuufkirchen.	Will and Fresenius.	
"	—	—	19.55	0.27	11.07	48.68	3.66	3.29	—	2.99	3.54	—	"	"	
"	—	—	9.68	—	14.58	52.06	1.62	3.90	—	3.57	4.61	—	"	"	
"	—	—	9.36	—	15.59	52.00	2.10	3.58	—	4.62	3.20	—	"	"	
"	—	—	10.37	—	15.04	43.45	2.26	5.50	—	5.20	6.39	—	"	"	
"	—	—	11.21	—	12.77	49.16	1.97	2.98	—	4.33	2.58	—	"	"	
Mean of 10 analyses of tobacco,	—	—	17.42	0.25	12.18	41.80	2.23	4.06	—	4.41	5.11	—	England.	Watts.	Carbonic acid, 11.01.
Hops,	—	—	19.41	0.70	5.34	14.15	14.64	8.28	17.88	2.71	3.0	—	"	"	
" (whole plant),	—	—	25.18	—	5.77	15.98	12.13	5.41	21.50	5.12	7.24	—	"	"	
" (leaves),	—	13.6	14.95	0.39	2.99	49.07	5.52	5.04	12.14	2.41	9.49	—	"	Nesbit.	
" (bines)	—	3.74	24.35	—	4.10	38.73	6.92	8.44	6.07	0.28	6.47	—	"	"	
Vine,	2.52	—	34.13	7.59	6.55	30.23	16.35	2.66	1.43	0.16	0.83	—	Styria.	Hruschauer.	
"	2.25	—	24.93	7.00	8.79	33.94	19.55	2.63	0.62	0.24	0.58	—	"	"	
"	2.85	—	37.48	1.33	1.05	43.88	9.20	3.61	0.72	1.61	1.61	—	Misnia.	Crasso.	
"	2.83	—	17.55	26.76	9.17	30.33	2.85	2.01	1.61	6.63	3.05	—	Worms.	Levi.	
"	2.69	—	25.31	2.14	7.48	40.87	17.94	2.88	—	2.49	0.87	—	Weinsheim.	"	
"	2.62	—	27.88	8.96	6.61	36.26	13.18	2.70	0.88	2.12	1.39	—	Giessen.	Will and Fresenius.	
Mean of 5 analyses of vine,	—	—	19.24	0.45	4.00	0.93	—	0.93	1.31	1.66	0.45	—	"	"	
Apple tree (<i>Pyrus Malus</i>), wood,	0.28	—	20.78	8.40	9.19	23.69	7.73	3.29	2.06	0.07	—	—	"	Engelmann.	
Cherry tree (<i>Cerasus communis</i>), wood,	10.37	—	7.46	14.53	5.10	41.95	3.26	0.80	19.98	0.20	0.62	—	"	"	
" bark,	—	—	27.09	3.61	13.01	7.69	42.02	2.67	0.75	1.19	2.57	—	Misnia.	Souhay.	
Quince seeds (<i>Pyrus Cydonia</i>),	—	—	33.89	3.56	6.91	12.87	34.81	3.30	0.35	0.24	2.31	—	"	"	
Leon seeds (<i>Citrus medica</i>),	—	—	15.43	4.52	6.91	49.89	13.47	5.78	1.75	1.03	1.18	—	St. Michael.	"	
Orange tree (<i>Citrus aurantium</i>), root,	4.48	—	11.69	3.07	6.34	55.13	17.09	4.64	1.22	0.57	0.25	—	"	"	
" stem,	2.74	—	16.51	1.68	5.72	56.38	3.27	4.43	4.83	0.32	6.66	—	"	"	
" leaves,	13.73	—	36.42	11.42	8.06	24.52	11.07	3.74	4.83	0.46	3.87	—	"	"	
" fruit,	3.94	—	40.28	0.92	8.74	18.97	23.24	5.10	1.13	0.80	0.82	—	"	"	
" seed,	3.30	—	36.98	6.76	3.61	11.14	9.74	12.43	8.43	1.09	7.85	—	"	"	
Turnip bulbs, mean of 10 analyses,	0.78	5.48	—	—	—	—	—	—	—	—	—	—	—	—	In this analysis, the carbonic acid seems to have been abstracted, and the result calculated after the deduction.
"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
" tops,	—	17.0	28.65	5.41	8.09	23.27	9.29	12.52	0.86	0.86	CL 16.05	—	—	Johnston.	

TABLE.—Showing the Composition of the Ashes of Grasses, &c.—continued.

NAME OF PLANTS, OR OF THEIR PARTS.	Ash in 100 parts.	Ash in plants analysed.	Potash.	Soda.	Magnesia.	lime.	Phosphoric Acid.	Sulphuric Acid.	Silica.	Peroxide of Iron.	Chloride of Sodium.	Chloride of Potassium.	Locality of Plant.	Analyst.	REMARKS.
Turnip tops,	—	—	15.21	2.84	2.81	28.49	6.17	8.43	3.99	1.08	15.30	5.04	—	Way and Ogden.	Carbonic acid 9.98. This is the mean of analyses of six varieties.
Beet roots, mean of 4 analyses,	0.88	6.30	30.80	12.19	2.91	3.65	4.19	3.03	4.44	1.24	24.55	—	—	Way and Ogden.	Carbonic acid, 6.49.
" tops,	1.37	—	21.25	7.01	8.66	8.65	5.15	5.80	1.99	0.96	33.96	—	—	"	Carbonic acid, 17.30; mean of 5 samples.
Carrot roots (white Belgian),	0.91	6.6	32.44	13.52	3.96	8.83	8.55	6.55	1.19	1.10	6.50	—	—	"	Carbonic acid, 17.82.
" top,	4.12	18.2	7.12	10.97	2.92	32.64	1.67	6.20	4.56	2.40	13.67	—	—	{ Roussingault and Fromberg.	The vegetable acids are by incineration converted into carbonic acid.
Potato tubers (mean of analyses), carbonic acid being deducted,	—	3.92	55.75	1.86	5.28	2.07	12.57	13.64	4.23	0.52	7.1	—	Oxford.	Daubeny.	* This column, in all Dr. Richardson's series, refers to the phosphate, not the peroxide of iron.
Potato tubers (mean of analyses), as obtained by incineration,	1.03	—	46.80	0.28	9.40	3.44	13.55	4.34	5.25	5.1	2.56	2.5	—	Thomas. Fromberg.	Oxide of manganese, 5.48.
Potato top,	—	14.96	28.02	16.26	7.09	16.96	7.62	6.88	3.85	1.05	118.35	—	—	—	—
Cabbage (leaves),	—	22.0	11.70	20.42	5.94	20.97	12.31	21.48	0.75	0.60	Cl. 5.77	—	—	—	—
Pine apple, whole fruit,	—	—	49.42	—	8.80	12.15	4.08	trace.	2.93	17.01	31.11	—	—	—	—
" top,	—	—	19.66	—	—	21.28	—	5.26	6.09	7.35	12.04	—	—	—	—
Asparagus,	0.47	93.27	6.01	34.21	3.03	4.39	18.51	4.13	13.47	3.31	12.04	—	—	—	—
Onion, bulb,	0.46	88.05	32.35	8.04	9.70	12.66	15.09	8.34	3.04	12.29	4.49	—	—	—	—
Fig, whole fruit,	0.84	93.53	13.98	14.43	trace.	25.10	—	10.50	19.77	10.61	trace.	—	—	—	—
Walnut, kernel,	—	—	28.36	24.14	9.21	18.91	—	6.73	5.93	2.76	4.02	—	—	—	—
" shell,	—	—	31.11	2.25	13.03	8.59	42.53	trace.	—	2.49	trace.	—	—	—	—
Quambeer,	0.63	97.78	23.10	2.74	4.13	30.57	—	14.96	14.43	10.07	—	—	—	—	—
Broccoli, heart,	1.01	87.96	47.16	—	4.26	6.31	14.97	4.80	7.12	2.06	9.06	4.19	—	—	—
" leaves,	1.70	87.42	22.10	7.55	3.93	4.70	24.83	10.35	0.60	2.12	trace.	—	—	—	—
Cauliflower, heart,	0.71	92.48	34.39	14.79	2.38	26.44	16.62	16.10	1.92	3.67	2.78	—	—	—	—
Radish, root,	6.43	65.10	21.16	—	7.03	8.78	40.09	7.71	8.17	2.19	7.07	1.20	—	—	—
" top,	2.76	88.10	5.05	11.09	3.58	27.90	6.07	9.44	8.22	16.45	8.50	—	—	—	—
Chestnut, whole fruit,	0.99	54.61	39.36	19.18	7.84	7.84	7.33	3.88	2.32	1.95	4.82	—	—	—	—
Strawberries, whole fruit,	0.41	90.22	21.07	27.01	trace.	14.21	8.39	3.15	12.05	11.12	2.78	—	—	—	—
Oranges, whole fruit,	—	—	38.72	7.64	6.55	22.99	14.17	2.95	5.24	1.74	trace.	—	—	—	—
Rhubarb, stalk,	1.23	85.90	14.47	31.77	5.59	10.04	12.83	1.89	2.77	2.77	8.84	—	—	—	—
" leaves,	2.03	90.53	9.69	34.96	5.20	13.11	7.89	9.30	3.16	8.67	7.93	—	—	—	—

TABLE—Showing the Composition of the Ashes of Grasses, &c.—continued.

NAME OF PLANTS, OR OF THEIR PARTS.	Ash in 100 parts.	Ash in plant and trifolium dried.	Potash.	Soda.	Magnesia.	Lime.	Phosphoric Acid.	Sulphuric Acid.	Silica.	Peroxide of Iron.	Chloride of Sodium.	Chloride of Potassium.	Locality of Plant.	Analyst.	REMARKS.
Ergot, ...	0.36	—	33.97	12.12	4.58	1.43	13.24	0.02	9.13	2.00	3.36	—	—	Engelmann.	[18-17. Red oxide of manganese, "

Alumina is the oxide of aluminum. With sulphuric acid and potash it forms alum, and with silica it produces the silicates of alumina, which form the different varieties of clay. It is uncertain whether the minute quantities of alumina found in plants are accidental or otherwise.

"Chemists are not yet agreed whether alumina ought to be classed among the inorganic ingredients used by plants for mineral food. It is certain that the substance stated to be alumina by their older analysts, and found in the course of their analyses of the ashes of plants, was in reality phosphate of lime. But if it be not directly useful to plants, it has a most powerful indirect influence upon their development, by determining the character of soils, of which it forms an essential constituent."—(Morton's *Cyclopedia of Agriculture*.)

In addition to this, it may be stated that alumina is a most powerful absorbent of ammonia.

Bromine is found in minute quantities in marine plants. Balard found that it existed in marine plants growing on the shores of the Mediterranean. It is, however, of no importance, in a horticultural point of view.

Chlorine occurs in the ashes of plants chiefly in combination with sodium and potassium, that is to say, as chloride of sodium and chloride of potassium.

Iodine exists in sponges and most kinds of sea weeds; indeed, it is principally obtained from *Fucus vesiculosus*, *nodosus*, and *serratus*.

Some marine plants are used as food, and their good effects are doubtless in a great measure owing to the iodine which they contain.

Iron.—The oxides of iron are found in the ashes of plants. It is supposed that they are taken up by the roots in the state of a sulphate, or in some other soluble form.

Lime, or the oxide of calcium, occurs in plants in combination with phosphoric, sulphuric, and carbonic acids, and in the form of organic salts. It is present, to a considerable extent, in the ashes of most plants, to some of which it is doubtless indispensable. The minute crystals found in the cells of plants chiefly consist of the phosphate and oxalate of lime.

Magnesia, or oxide of magnesium, is found in the ashes of most plants. It may, therefore, be considered an essential element of

their nutrition. It is supposed to be taken up by the roots of plants in the state of bicarbonate of magnesia, which is soluble.

Manganese.—The oxide of manganese is found in small quantities in the ashes of many plants. Its presence is, however, believed by chemists to be accidental.

Phosphorus never exists in nature in a free state; combined with oxygen it forms phosphoric acid, a most important compound, which unites with various bases, such as potash, soda, lime, magnesia, &c., forming a class of salts called phosphates.

Phosphoric acid, in the form of phosphates, enters into the composition of all plants, and is found in all fertile soils. Manures also owe much of their value to the presence of this acid.

Potash is a compound of potassium and oxygen, and is an important constituent of plants. It is found largely in the ashes of turnips, potatoes, and many other plants, as will be perceived by the foregoing table.

Silica, or silicic acid, is a compound of silicon with oxygen. It enters into the composition of all soils, and is present in some plants in large quantity. The ashes of the straw of wheat contain as much as 70 per cent. of silica; those of hay, about 30 per cent.; and ryegrass, as much as 64 per cent. of this substance. The silica of plants is doubtless obtained by the decomposition of the silicates of potash and soda by carbonic acid, which seizes on the alkaline base, and sets free the silica in a soluble form.

Soda is a compound of the metal sodium and oxygen, and generally occurs together with potash in plants. It appears that soda may, to a certain extent, be substituted for potash, and that potash may also partially replace soda, but how far this substitution of the one base for the other takes place is not known; it is, however, certain, that in no case can potash be wholly replaced by soda, or the reverse.

Sulphur exists in plants in the form of sulphates, or combinations of sulphuric acid with various bases, and also in the vegetable albumen. The ashes of turnips, cabbages, and other plants of the brassica tribe, are rich in sulphuric acid, of which they contain from 10 to 20 per cent.

Sulphur is supposed to be taken up by plants in two ways: in the shape of sulphates, and as sulphuretted hydrogen.

CHAPTER IV.

ASSIMILATION OF THE FOOD.

MODE OF ABSORPTION.—Having treated on the principal organs of plants, and on the substances which form their food, we shall now endeavour to explain the mode in which the food is taken up and appropriated by the plant.

Plants feed almost exclusively by the roots, and chiefly by the young extremities of these, called the spongioles, from their property of imbibing fluids like a sponge. These spongioles are composed of a delicate tissue through which no solid substance can pass. Water in its liquid state, and also in that of vapour, is readily absorbed, provided the plant is at the time in want of a supply of moisture. If a plant is dry and the leaves are flagging, by immersing its spongioles entirely in water the leaves will resume their natural position, and they will do so to a considerable extent if the spongioles are placed in an atmosphere completely saturated with the vapour of water. Thus, moisture, either in the fluid or gaseous state, can be taken up; and so can other substances, even some that are solid when reduced to a soluble state, provided the solution is not too dense. Water, however, cannot be taken up by the roots and carried to the tops of the highest trees, and there evaporated by the leaves, in many cases to the amount of tons in the course of a summer, without a force, or an aggregation of forces, equal to the weight raised. The tubes in the vegetable structure, being exceedingly fine, have doubtless a capillary action; but this alone could not be sufficient to force the sap through the cut stem of a vine so as to burst a strong fastening placed over the section of the stem, as is known to have been the case.

The mode in which fluids pass through membranous tissue was, we believe, first pointed out by M. Dutrochet, and called Endosmose. By this discovery, not only the absorption by the roots, and that which takes place from cell to cell, is clearly accounted for, but also a part of the circulation of plants which had previously been considered inexplicable.

"If a small bladder, either of animal or vegetable membrane, containing a liquid denser than water, such as a mixture of sugar and

water, is plunged in pure water, the two liquids will tend to become of the same density, and to establish through the sides two currents, one of pure water passing, from without, inwards towards the sugar and water (called endosmose); and another of sugar and water passing from the inside to the outside and towards the pure water (this current is called exosmose). But the two liquids do not filter through the membranes with equal facility or rapidity. The less dense passes through the quickest; the sugared water, therefore, gains more than it loses, the pure water loses more than it gains. Hence, a difference of level takes place between the two liquids, that in the bladder rising highest, and continuing to do so till the two liquids have acquired, by this interchange, an equal degree of density. If we insert a graduated upright glass tube into the mouth of the bladder, tying the latter tightly, so that the fluid in ascending can only pass up the tube, we can thereby ascertain the rapidity of the ascent and its force. If we substitute a bent tube for the straight one, and fill the lower part of the bend with mercury, the latter will stand at the same level in both legs of the tube; but when pressed by the fluid, the mercury will be forced down the one leg and up the other, and the difference between the height of the two columns shows the force exerted by the endosmose action. It has been ascertained by such experiments that the rapidity and force of the endosmose are considerable, and that its action will continue for a long time. A solution of 1 part of sugar to 2 parts of water raised, in two days, the column of mercury as much as 40 inches, equal to the pressure of about 19½ lbs. on the square inch. At the end of the two days the solution was only reduced to 3 parts of water to 1 of sugar.

"Absorption by the roots can be now easily explained. The cells which form their tissue are filled with fluids denser than the water in the soil; and this water, by the effect of endosmose, filters through the membranes of the tissue into the outside cells, diminishing the density of the fluids it there meets with, and passes from these into the interior cells. From this it is evident, that if we imagine we shall favour the nourishment of the plant by furnishing it with food already prepared, by bringing its roots, for example, in contact with a solution of sugar, we shall thereby prevent the endosmose action, and consequently the ab-

sorption; and thus, instead of gaining our object, we should, on the contrary, frustrate it."—(*A. De Jussieu.*) In the application of artificial manures, we ought therefore to be careful not to supply such except in a sufficiently diluted state.

As the life of plants depends on the transmission of fluids through very delicate membranes, and as this transmission is effected by endosmose action, as above stated by M. De Jussieu, the nature of this action ought to be well understood; for otherwise, we may supply good nourishment to plants that may, nevertheless, be worse than useless to them in consequence of our not applying it in that diluted state which would enable the action in question to take place. A knowledge of the process may, therefore, be productive of beneficial results; and we believe we cannot do better than add the following extract from an excellent account of it by Mr. Rainey, in the *Philosophical Magazine*, vol. xxix. p. 179:—

"It is a fact which probably no one will question, that, when two fluids of unequal density are brought into contact in minute quantities, without any membrane being interposed, they will intermix by diffusion, the rarer fluid intermingling itself with the denser one, and the denser fluid diffusing itself through the rarer one, until the one becoming gradually more dense, and the other less so, the whole mass acquires one uniform consistency. However, should this fact be doubted, it can be well illustrated by introducing between two surfaces of glass, placed almost in contact, some thick mucilage and a little thin coloured fluid of any kind, for instance, common writing ink, and observing with the microscope the part where they become united, when the two fluids will be seen gradually to intermix, and to become so blended together, that their line of union will become lost.

"The same fact can be shown by introducing some mucilage into a piece of thermometer tube, and after it, at the same end, some writing ink. The coloured fluid will at first pass only in a small column through the mucilage, along the centre of the tube, leaving the mucilage in contact with its parietes, but afterwards they will become gradually blended together. Also by filling a piece of thermometer tube with water, closing its upper extremity, and placing it vertically with its lower one in a solution of gum coloured with logwood, when the latter will gradually ascend and colour

the former, showing that the diffusion is independent of gravity, and therefore may be inferred to be the result of that attraction which is exerted universally between the particles of matter, varying in the inverse ratio of the squares of their distances, and in the direct ratio of their masses; the particles, in this instance, upon which the difference of density of the two fluids depends, being contained in a medium which allows of their free motion one upon another, cannot, therefore, come to a state of rest until every one of them is attracted equally on all sides, that is, until all the fluid is of one density. It is also a fact equally unquestionable, that if solutions of the same substance in the same menstruum, but of different densities, be filtered through the same membrane, the more rare fluid will pass through it with greater rapidity than the denser one. This is one of the effects of the same principle of attraction, the dense fluid being in this case more strongly attracted by the material of which the membrane is composed than the rare one.

"Now, when two fluids of different densities are separated by a porous membrane, the porosities, being merely a multitude of capillary tubes, like the space between the pieces of glass or the tube of the thermometer, will allow of the passage through them of the particles of one solution into the other; and they will become mixed together by diffusion the same as if no regular membrane were present, as in the experiments just detailed; so that electricity may just as well be regarded as the cause of diffusion as of endosmose, these being the same. However, the membrane being traversed by an immensity of extremely minute porosities, will extend the surface of the two fluids between which it is placed, and in this way, bringing into close proximity a great number of particles, place them under circumstances very favourable for the operation of the force of attraction of one particle for another. But the characteristic feature of endosmose and exosmose is, that the rarer fluid passes through the interposed membrane more rapidly than the denser one; and therefore that an accumulation takes place on that side of it on which the latter was placed. The reason of this is obvious; for, had it been otherwise, or even had these quantities been equal, then the rarer fluid must have repassed through the interposed membrane after its density had been increased by its intermixture

with the denser fluid, as rapidly as it passed through it before its density had been thus augmented; or from the commencement of the operation the dense fluid must have passed with the same velocity through the membrane as the rare one, which is contrary to the second fact. Therefore, in case of diffusion of two fluids of unequal densities through a porous partition, the fluid *MUST accumulate* on that side of the partition on which is situated that fluid which passed through it most slowly.

"This explanation is applicable in all cases in which the rarer fluid on the one side of the membrane has the same chemical properties as that on the other side, their difference being only in their degree of density.

"If these fluids be dissimilar in respect to their chemical qualities, still the accumulation will take place on that side of the membrane on which was situated the fluid which passed through it most slowly, although its density may be less than the other; thus, for instance, when a bladder full of air is surrounded with carbonic acid, the latter enters faster than the former escapes, and the bladder bursts. Now, it is found by experiment that carbonic acid passes through wet membrane quicker than atmospheric air, although of a greater density.

"In such instances the relative velocities of the passage of different fluids through membrane will be influenced by their chemical attraction for the material of which the membrane is composed, as well as by that attraction which is regulated by quantity of matter, and in some cases the existence of the latter force may be so modified by the former as to be wholly inappreciable; but still that force, being an universal agent, and acting upon all matter according to invariable laws, is in operation in every instance where the conditions requisite for endosmose and exosmose are present, although in some cases chemical attraction or electricity may have no demonstrable existence; and therefore it may be looked upon as the essential cause of endosmose and exosmose—chemical affinity, electricity, &c., being merely the modifiers of its operation, and, in respect to it, secondary agents."

ASCENT OF THE SAP.—The flow of sap is not, however, governed entirely by the forces which enable fluids to pass readily through the tissues, and to ascend to a considerable height above the level of the source from which these fluids are derived. These forces must diminish

with elevation, and endosmose would almost neutralize itself when it had infiltrated as much watery fluid as would render the contents of the tissues of nearly the same density as water. The flow of sap is induced by heat, supplied by endosmose, aided by capillary attraction, and promoted by evaporation.

In winter the sap is almost at rest. Buds of most trees swell but little; those at the termination of the shoots destined to elongate the branches do not extend till acted upon by heat. In proof of this, let a tree be planted outside a forcing-house, and let a portion of it, say one branch, be introduced into the inside in heat in winter, whilst the rest of the tree remains in the cold; supposing the branch so introduced to be that of a vine, it will begin to push its buds and leaves, and will form young shoots, while the branches on the portion outside will remain in a leafless condition; their buds will not swell, provided the weather continue cold, and in this case they may be cut without the sap oozing from the wound, therefore it must be concluded that there is no flow taking place in that part of the vine. But such cannot be the case with the branch introduced into heat; for, if it be cut after its buds begin to swell, the sap will flow copiously. It is, therefore, evident that the flow of sap is greatly influenced by heat.

The introduction into heat of plants that are in a dormant state, in order to *start* them, is a common expression among gardeners, and briefly signifies that the plant is to be introduced to a temperature sufficiently high to set the sap in motion; for this is the first effect of the heat, and that by which the plant is started into growth.

The ascent of the sap takes place chiefly through the more recently formed woody tissue of the stem. If a young branch be cut across, the sap will be seen to flow from the whole surface of the section; but, in an old stem or branch, the flow is chiefly through the youngest layer of wood, that next the outside, and partly through the layers next and interior to this, but very little or none through the old heart-wood. The sap, flowing chiefly through the outer layer of woody tissue, continues its course through the same kind of tissue into the bud, young shoot, and upper surface of the leaves. In these its general upward movement from the root terminates; it is there exposed to light and air; various changes are effected by these, and in

an altered form it retrogrades, receiving then the names of *descending*, *returning* or *elaborated sap*, and also that of *proper juice*.

CHANGES WHICH THE SAP UNDERGOES.— Having explained the mode in which the sap is absorbed by the roots and conveyed through the stem, chiefly by the vessels of the albumen, into the young shoots and leaves, we shall now endeavour to point out some of the more important changes which it undergoes, and the agencies by which these changes are effected.

As the vessels through which the sap ascends contain various organic and inorganic substances, some chemical action probably takes place when these substances are brought in contact with others held in solution by the ascending sap. In order to satisfy chemical affinities, portions of some substances may be taken from the sap; and, on the contrary, it may obtain other ingredients from the deposits in the cells through which it passes.

Although the sap appears to be changed to some extent in its passage through the stem, yet the principal alterations of its nature take place in the leaves. In these it parts with a large amount of water by evaporation or perspiration, carbonic acid is decomposed, and other chemical changes take place.

Dr. Hales, in his *Treatise on Vegetable Statics*, gives an account of some excellent experiments with regard to the evaporation of fluids by plants. In July or August he cut off several branches of apple, pear, apricot, and cherry trees, two of a sort. They were from 3 to 6 feet long, with lateral branches, and about 1 inch in diameter where cut off. He then stripped off the leaves from one branch of each sort, and put each of the branches, with leaves and without leaves, in separate glasses, pouring in known quantities of water. The boughs with leaves on them imbibed, in twelve hours of the day, from 15 to 30 oz., more or less in proportion to the quantity of leaves they had, and when he weighed them at night, they were lighter than in the morning. Those without leaves imbibed but 1 oz., and were heavier in the evening than in the morning, they having perspired little.

The quantity imbibed by those with leaves decreased very much every day, and usually in four or five days the leaves faded and withered much.

At the above rate the average quantity evaporated by each branch would amount to

1 gallon in a week; and, if the tree consisted of fifty such portions of branches and foliage, the amount of its evaporation would be 50 gallons, or equal to nearly a quarter of a ton of water.

Dr. Hales also found that the evaporation from a middle-sized cabbage plant amounted in twelve hours of one day in summer to 19 oz.; and that its average evaporation on nine several days was 15 oz. in the day of twelve hours. This was at the rate of fully 29 lbs. of water per month.

Although evaporation is effected chiefly by the leaves, yet it also takes place, to a greater or less extent, from all parts of the surface of plants exposed to air not actually saturated with moisture. If a shoot is cut off before the leaves expand, and if the cut be waxed over so that no moisture can exhale from that part, yet evaporation will proceed through the bark till the whole shoot becomes dried up. This, however, would not be the case so soon as if the shoot were in leaf: for example, if two similar shoots are cut from the same tree, say for budding in July, when the sap is in full flow, and if the leaves be all cut off from the one shoot, and none of them from the other, it will be found that the one with leaves will soon become exhausted of its sap, and unfit for budding, whilst the one deprived of leaves may be successfully worked several days after the other has become too dry.

Evaporation takes place in much greater quantity from some plants, than from others having an equal extent of evaporating surface. Some, with succulent fleshy leaves, may be exposed to great drought without being dried up; whilst such plants as have broad hairy leaves, would be quite withered by exposure to the same degree of dryness. Evaporation from the surface of leaves is well known to be, from equal areas, exceedingly variable. Whether much or little is evaporated, depends chiefly on the porosity of the surface. The pores differ in size and number; and a leaf, of which the outline incloses an area of perhaps 6 square inches, may have a much greater evaporating surface from being covered with hairs, or otherwise not perfectly even. However, from exact experiments, and from the quantities of water which plants in pots require, some twice as much as others under the same circumstances, it is certain, that evaporation takes place from most plants to a great extent, and from some more than

others. The process cannot be carried on when the air surrounding the plant is already charged with moisture to saturation; but when the surrounding air is not saturated, evaporation from plants will go on; and if the dryness of the air be excessive, so will be the evaporation. It appears that the moisture in the living plant is as much subject to evaporation as it would be in any substance not alive. If a wet sponge is exposed to dry air, the latter, as it comes in contact with the moisture, will successively absorb it till the sponge becomes quite dry; and this is precisely what takes place with plants, dry air coming in contact with the moisture in the pores of the leaves or bark, carries it off, and the more rapidly if the air is moving quickly. If we take a shallow metal box, say two inches square, nearly fill it with water, and fit a lid very exactly so that it may rest on the surface of the water, from which it effectually prevents the access of air; it is evident, in this case, that, although exposed to dry air, no evaporation of the water could take place. If we now remove the metallic lid, and substitute two inches square of blotting paper, placing it on the surface of the water, and exposing it to dry air, we shall find the water will be evaporated, so that, ultimately, even the blotting paper itself will remain dry at the bottom of the box. The blotting paper is porous, and so is the surface of leaves; and any porous substance in contact with moisture on the one side, and with dry air on the other, permits the moisture to escape by evaporation, under circumstances favourable for this taking place. As evaporation cannot go on in a saturated atmosphere, and as some plants naturally grow in countries where the air is generally dry and clear for considerable periods in the intervals of heavy rains, and as a great amount of evaporation must be effected during these periods, it cannot be supposed that a healthy substantial growth will result from keeping such plants in a house or pit where the air is constantly damp. On the other hand, there are plants which grow in shady, moist situations, and like a humid atmosphere, either continually, or during a certain stage of their growth; for these, a dry atmosphere, day and night, with fire-heat, must be destructive. It may be here remarked, that even in dry climates there is a cessation of evaporation during the night, dew being then usually

formed, and the air saturated with moisture, so that evaporation is checked.

Hales found that the evaporation from a plant of the sunflower was 30 oz. in a dry warm day, and it was nothing at night when there was a slight dew.

Whilst a large portion of the sap which enters into the tissues of the leaves is disposed of simply by evaporation, changes are effected on the remaining portion by the action of light.

The most important and uniform of these is the decomposition of carbonic acid, the oxygen of which is, in a great measure, restored to the atmosphere, and the carbon retained and appropriated in various ways by the plant.

That carbonic acid is decomposed in the green parts of plants by the action of light, has been conclusively proved by De Candolle and others.

"If," says De Candolle, "two plants are exposed, one to darkness and the other to the sun, in close vessels, and in an atmosphere containing a known quantity of carbonic acid, and are removed at the end of twelve hours, we shall find that the first has diminished neither the quantity of oxygen nor of carbonic acid; and that in the second, on the contrary, the quantity of carbonic acid has diminished, while the quantity of free oxygen has increased in the same proportion. Or if we place two similar plants in closed vessels in the sun, the one in a vessel containing no carbonic acid, and the other in air which contains a known quantity of it, we shall find that the air in the first vessel has undergone no change, while that in the second will indicate an increase of oxygen proportionate to the quantity of carbonic acid which has disappeared; and if the experiment is conducted with sufficient care, we shall discover that the plant in question has gained a proportionable quantity of carbon. Therefore, the carbonic acid which has disappeared has given its oxygen to the air and its carbon to the plant, and this has been produced solely by the action of solar light."

By means of the decomposition of carbonic acid by plants, oxygen is restored to the atmosphere, which is being continually robbed of that element by the respiration of animals, combustion, and other means. Although oxygen is withdrawn from the air by plants at night, yet this loss appears to be more than compensated by the amount restored during

the day. We may therefore conclude, that this is a provision of nature for the maintenance of the elements of the atmosphere in their proper proportions. And as the food of animals is always derived directly or indirectly from vegetables, it is evident, that as the number of the former increases, so must that of the latter, to supply the greater demand for food; and that if a greater amount of oxygen is withdrawn from the air by animal life, the means of compensating for that loss is also greater in consequence of a larger amount of vegetable matter being required for food.

But besides the decomposition of carbonic acid, many other chemical changes are effected on the constituents of the sap in the leaves, and by which they acquire peculiar properties, such as they cannot obtain in the absence of light. For example, celery grown in the light has a strong flavour, but when grown in the dark, or blanched, it is rendered agreeable to the taste.

The modifications by which the juices are rendered in some leaves sweet, in others, bitter, acrid, insipid, acid, or perfumed, &c., are induced or influenced by the agency of light.

Whilst the leaf is in a young state, it appropriates, for its own growth, the principal part of the sap it elaborates; but as it gets older it affords a supply for the growth and nourishment of the other parts of the plant.

IV.—DESCENT OF THE SAP.

The elaborated sap returns from the leaf by a different set of vessels from that through which the crude ascending sap is conveyed and introduced into it. The general flow of sap from the roots takes place chiefly through the vessels of the alburnum, or young layer of wood; whilst the elaborated sap returns by the liber or inner bark. In its progress downwards, it deposits secretions, and in exogens it forms a fresh layer of wood, sometimes of considerable thickness, in the course of a season, as may be seen by the concentric layers which indicate each season's growth.

Part of the elaborated sap reaches the extremities of the roots, adding fresh organized tissue to the existing spongioles, and forming new ones; and thus, whilst the size of the plant increases above ground, means are provided for supplying it with an additional quantity of nourishment. Roots can-

not be formed without leaves or substances which have been elaborated by leaves. A plant may be cut down near the ground, and, under favourable circumstances, its roots will grow for a time; but, if no leaves are permitted to push, the roots must ultimately perish. On the other hand, leaves may be produced without roots, as may be observed on fresh shoots springing from the trunks of felled trees; but these shoots are supported by the sap contained in the trunk, and which has been elaborated by the leaves. This supply must, however, ultimately become exhausted, and then growth must cease. We are, therefore, led to the conclusion, that the action of leaves and roots are reciprocal, so that, if we reduce the former, we shall thereby diminish the growth of the latter, and *vice versâ*.

We have supposed that plants feed almost exclusively by their roots; but many contend that much of their nourishment is derived from the substances constituting the air, or which are contained in it, such as oxygen, nitrogen, carbonic acid, and ammonia. Attempts have, accordingly, been made to feed plants by their foliage with the two latter, but with no appreciable result; whereas, by supplying these substances in a properly diluted form to the roots, the effects are most decidedly beneficial.

CHAPTER V.

SOILS.

Soils are constituted originally of various mineral and saline substances; and, subsequently, these have, in most cases, acquired the addition of a greater or less amount of organic substances.

The mineral or inorganic substances in the soil are derived from the degradation or decomposition of rocks; the organic, from the decay of animal or vegetable matter.

The processes of degradation are effected by the action of water, carbonic acid, and oxygen. Rocks that are fissured are liable to be broken up by the freezing of water, and the hardest rocks are decomposed by chemical action. Several substances are frequently united in the same rock or stone. Thus, three very different minerals are united in granite, namely, quartz, felspar, and mica.

The quartz has 99 per cent. of silica; the felspar is composed of about 60 per cent. of silica, 22 of alumina or clay, 14 of potash, 1 of lime, and 1 of oxide of iron; the mica is composed of 46 per cent. of silica, 30 of alumina, 8 of potash, and 8 of oxide of iron.

"Quartz is not a silicate, but pure silicic acid; carbonic acid cannot, therefore, act upon quartz so as to cause its disintegration. Mica consists of silicate of alumina, persilicate of iron, and silicate of potash. Carbonic acid, being capable of combining with the potash, decomposes the latter salt, forming with its potash carbonate of potash, and liberating silicic acid. This decomposition of one of its constituents, is, of course, attended with the disintegration of the mica. Lastly, felspar is a double salt, composed of silicate of alumina and silicate of potash. This ingredient of the granite is far more readily disintegrated than mica; it separates into silicate of alumina, persilicic acid, and carbonate of potash. The two latter substances dissolve, and are carried away by water, whilst the silicate of alumina remains undissolved, and, according to its degree of purity, receives the name of common clay, or porcelain clay.

"It must be obvious that in the process where two of the constituents of the granite are decomposed and disintegrated, the whole mass of the granite must, in a like manner, suffer degradation."—(*Lectures to Farmers on Agricultural Chemistry*, by Alexander Petzholdt.)

The same author remarks, "that carbonic acid decomposes only those silicates with the bases of which it will combine and form carbonates, while it leaves untouched the silicates, with the bases of which it is incapable of combining. The former, therefore, only can be disintegrated by the action of carbonic acid. Now, those silicates which occur as constant constituents of all mountain masses, are exclusively combinations of silicic acid with alumina, peroxide of iron, potash, soda, lime, magnesia, protoxide of iron, and protoxide of manganese. With the exception of alumina and peroxide of iron, all these bases are capable of combining with carbonic acid. All the minerals we are speaking of are double salts, and every one of them contains at least one silicate, the base of which has a tendency to combine with carbonic acid," forming a carbonate, the silicic acid being set free. This is at first soluble in a large quantity of water, from which it gradually separates, becomes

insoluble, and is ultimately converted into solid flint.

The action of oxygen likewise contributes to the disintegration of rocks. These generally contain more or less of some oxide of iron containing less oxygen than that which forms the peroxide. If moisture is present, these oxides absorb oxygen from the water till they are converted into peroxide of iron. Now, any oxide of iron requires more space than the pure metal, and the peroxide still more than when the metal is in a less oxidized state, and the consequence is a breaking up of the mineral. If pieces of iron be employed to bat stones in buildings, the iron, if water has access to it, is apt to split the stones from the greater bulk which it acquires in rusting. In some old buildings, portions of the stone may be seen completely wedged off by the iron. Thus oxygen acts chemically on the iron, and by the combination of the two substances, the stone is mechanically broken.

By the action of carbonic acid, water, and oxygen, a fertile soil can be produced from one of the most abundant and strongest rocks in nature, granite. In it are associated, as previously stated, three distinct minerals—quartz, mica, and felspar. On the disintegration or degradation of these by the agencies above-mentioned, the basis of a fertile soil is formed, consisting of the following ingredients: derived from the quartz, flint, sand, or silicious earth; from the mica, silicate of alumina or fine clay, lime, oxide of iron; from the felspar, silicate of alumina, silicate of potash, lime, oxide of iron. In addition to these there are phosphates in the granite of some localities. Thus, the essential inorganic constituents of the soil are derivable from the substances in one kind of primitive rock, and other kinds of rocks are liable to be broken up or decomposed by the same agencies so as to form soils.

The organic portions of the soil are, of course, subsequent acquisitions to the inorganic constituents, inasmuch as the former are derived from the decay of plants and animals; and as the decay of these could not precede their existence, they must have lived originally on soils destitute of organic remains.

Decayed vegetable matter assumes a dark brown or black colour, and is termed *humus*, or *mould*. This is formed by the gradual decay of vegetable and animal matter under the influence of water, air, and heat. Liebig

defines it as woody fibre in a state of decay, and states that it is formed by the oxygen of the air slowly uniting with woody fibre. This process he terms *eremacausis*, a species of tardy combustion, which goes on till the woody fibre is converted into humus. It was once the prevailing opinion that humus was the source from which plants derived their carbon; but this has been disproved by Liebig, who has shown that there is no evidence whatever that humus is directly absorbed by plants, and that it could not be formed unless plants had some other source from which they could derive carbon; for the first vegetables which grew on the earth could not have obtained their carbon from humus, which, being formed by the decay of vegetables, could not then exist. Nevertheless, it cannot be doubted, that humus performs an important part in the nutrition of plants. By its slow decomposition, it affords a constant supply of carbonic acid to the roots. It also, probably, supplies ammonia, which it absorbs from the atmosphere.

It is evident to any one who has observed the nature and disposition of soils, that vast quantities of them have been removed from the localities in which they have been originally formed. It is certain that violent eruptions of nature have disturbed the solid masses, scattering, at the same time, the disintegrated portions that may have been previously reduced to the state of soils. Light sandy soils, in some localities, are even now being drifted from place to place by the winds. But the effects of water, with regard to the transportation of soils, are much more powerful and universal than those resulting from the action of wind. Those effects can be traced almost everywhere in a greater or less degree. From the quantities of marine shells that are found inland, and at considerable elevations, it would appear that the sea had at some remote period rolled over the low-lying parts of Britain, and had swept before it different substances and kinds of soil. The land may have sunk, for some time, considerably below the level of the sea, or the latter may have risen above the surface of the land; in either case, the soil and the looser portions of rocks would be moved by the overwhelming force of the mass of water. An irregular mixture of these would take place in the first instance, and, unless the submerged surface had been previously level, and its materials of uniform density, the flow of water could not have been uni-

formly onward, and hence a circuitous motion, partaking of the nature of a whirlpool, must have been communicated. To this, or some very analogous cause, must be attributed the formation of those numerous, apparently water-formed eminences, which diversify the general level of the low part of the country, and present aspects more or less inclined to the sun, and, consequently, better adapted for the growth of a greater variety of vegetable productions than a level plain. By the reaction of the water, depositions of the portions of soil capable of acquiring a muddy consistence would be formed, and through these rivers would trace their course. The beds of many of these are far above the bottoms of the original valleys; the latter appear to have been previously filled up to a great extent by different transition strata. The mechanical effects of water are now generally confined to the gradual washing down of the soluble and finer portions of soil from the higher to the lower grounds, or into rivers, to be either deposited where these overflow, or to be carried into the sea. It should, therefore, be an object in good cultivation to prevent, as much as possible, the soil from being carried down from the higher ground, where it is most wanted, to the lower, where it is least required, and where its depth, in many cases, is already more than sufficient.

I.—CLASSIFICATION OF SOILS.

From what has been stated, it will appear that the inorganic bases of soils consist of substances derived from various kinds of rocks. The bulk of these substances consists of *silica*, *clay*, and *lime*. Being mechanically mixed in no definite proportion, these, together with organic remains, *humus*, afford an infinite diversity of soils, independently of the few or many saline matters which they may also contain in greater or less quantity. As the varieties of soils are so numerous, and merge one into the other, possessing no natural lines of demarcation, it is evident that some system of classification must be adopted in order that we may know with sufficient exactness what is meant by the term used to designate any particular variety of soil. Accordingly, many systems of classification have been proposed; but the following one appears to be the most complete, and would, if generally adopted, prevent, in a great measure, the confusion which so frequently arises from the indefinite

use of the terms, sandy, clayey, calcareous, &c., as applied to soils; and also that of local terms to which different meanings are attached in different parts of the country. This system is founded on the principle that soils generally consist of a mixture of clay, lime, humus, and silica, as above stated; and the divisions and subdivisions are formed according to the proportions in which the above constituents are present :—

SCHUBLER'S CLASSIFICATION OF SOILS, AS RECOMMENDED BY DR. DAUBENY.

(From the Journal of the Royal Agricultural Society of England, vol. iii. p. 156.)

NAMES OF DIFFERENT DESCRIPTIONS OF SOIL.			PROPORTION OF INGREDIENTS IN EVERY 100 PARTS.			
CLASSES.	ORDERS.	SPECIES.	CLAY.	LIME.	HUMUS.	SAND.
I. ARGILLACEOUS SOILS. Above 50 per cent. of Clay. Not more than 5 per cent. of Lime.	Without Lime	Poor.....	Above 50	0	0· to 0·5	The
		Intermediate...	„ 50	0	0·5 to 1·5	Remainder.
		Rich.....	„ 50	0	1·5 to 5·0	„
	With Lime	Poor.....	Above 50	0·5 to 5·0	0· to 0·5	„
		Intermediate...	„ 50	0·5 to 5·0	0·5 to 1·5	„
		Rich.....	„ 50	0·5 to 5·0	1·5 to 5·0	„
II. LOAMY SOILS. Not more than 50, nor less than 30 per cent. of Clay. Not more than 5 of Lime.	Without Lime	Poor.....	30 to 50	0	0· to 0·5	„
		Intermediate...	30 to 50	0	0·5 to 1·5	„
		Rich.....	30 to 50	0	1·5 to 5·0	„
	With Lime	Poor.....	30 to 50	0·5 to 5·0	0· to 0·5	„
		Intermediate...	30 to 50	0·5 to 5·0	0·5 to 1·5	„
		Rich.....	30 to 50	0·5 to 5·0	1·5 to 5·0	„
III. SANDY LOAMS. Not more than 30, nor less than 20 per cent. of Clay. Not more than 5 of Lime.	Without Lime	Poor.....	20 to 30	0	0· to 0·5	„
		Intermediate...	20 to 30	0	0·5 to 1·5	„
		Rich.....	20 to 30	0	1·5 to 5·0	„
	With Lime	Poor.....	20 to 30	0·5 to 5·0	0· to 0·5	„
		Intermediate...	20 to 30	0·5 to 5·0	0·5 to 1·5	„
		Rich.....	20 to 30	0·5 to 5·0	1·5 to 5·0	„
IV. LOAMY SANDS. Not more than 20, nor less than 10 per cent. of Clay. Less than 5 per cent. of Lime.	Without Lime	Poor.....	10 to 20	0	0· to 0·5	„
		Intermediate...	10 to 20	0	0·5 to 1·5	„
		Rich.....	10 to 20	0	1·5 to 5·0	„
	With Lime	Poor.....	10 to 20	0·5 to 5·0	0· to 0·5	„
		Intermediate...	10 to 20	0·5 to 5·0	0·5 to 1·5	„
		Rich.....	10 to 20	0·5 to 5·0	1·5 to 5·0	„
V. SANDY SOILS. Not more than 10 per cent. of Clay. Less than 5 per cent of Lime.	Without Lime	Poor.....	0· to 10	0	0· to 0·5	„
		Intermediate...	0· to 10	0	0·5 to 1·5	„
		Rich.....	0· to 10	0	1·5 to 5·0	„
	With Lime	Poor.....	0· to 10	0·5 to 5·0	0· to 0·5	„
		Intermediate...	0· to 10	0·5 to 5·0	0·5 to 1·5	„
		Rich.....	0· to 10	0·5 to 5·0	1·5 to 5·0	„
VI. MARLY SOILS. More than 5, not more than 20 per cent. of Lime.	Argillaceous.	Poor.....	Above 50	5 to 20	0· to 0·5	„
		Intermediate...	„ 50	5 to 20	0·5 to 1·5	„
		Rich.....	„ 50	5 to 20	1·5 to 5·0	„
	Loamy.	Poor.....	30 to 50	5 to 20	0· to 0·5	„
		Intermediate...	30 to 50	5 to 20	0·5 to 1·5	„
		Rich.....	30 to 50	5 to 20	1·5 to 5·0	„
	Belonging to the Sandy Loams.	Poor.....	20 to 30	5 to 20	0· to 0·5	„
		Intermediate...	20 to 30	5 to 20	0·5 to 1·5	„
		Rich.....	20 to 30	5 to 20	1·5 to 5·0	„
	Belonging to the Loamy Sands.	Poor.....	10 to 20	5 to 20	0· to 0·5	„
		Intermediate...	10 to 20	5 to 20	0·5 to 1·5	„
		Rich.....	10 to 20	5 to 20	1·5 to 5·0	„
	Humus.	Clayey	Above 50	5 to 20	Above 5·0	„
		Loamy	30 to 50	5 to 20	„ 5·0	„
		Sandy	20 to 30	5 to 20	„ 5·0	„

Schübler's Classification of Soils—Continued.

NAMES OF DIFFERENT DESCRIPTIONS OF SOIL.			PROPORTION OF INGREDIENTS IN EVERY 100 PARTS.			
CLASSES.	ORDERS.	SPECIES.	CLAY.	LIME.	HUMUS.	SAND.
VII. CALCAREOUS SOILS. Containing more than 20 per cent. of Lime.	Argillaceous.	{ Poor.....	Above 50	Above 20	0 to 0·5	The
		{ Intermediate...	" 50	" 20	0·5 to 1·5	Remainder.
		{ Rich.....	" 50	" 20	1·5 to 5·0	"
	Loamy.	{ Poor.....	30 to 50	Above 20	0 to 0·5	"
		{ Intermediate...	30 to 50	" 20	0·5 to 1·5	"
		{ Rich.....	30 to 50	" 20	1·5 to 5·0	"
	Belonging to the Sandy Loams.	{ Poor.....	20 to 30	Above 20	0 to 0·5	"
		{ Intermediate...	20 to 30	" 20	0·5 to 1·5	"
		{ Rich.....	20 to 30	" 20	1·5 to 5·0	"
	Belonging to the Loamy Sands.	{ Poor.....	10 to 20	Above 20	0 to 0·5	"
		{ Intermediate...	10 to 20	" 20	0·5 to 1·5	"
		{ Rich.....	10 to 20	" 20	1·5 to 5·0	"
	Sandy.	{ Poor.....	0 to 10	Above 20	0 to 0·5	Any portion less than 80 per cent.
		{ Intermediate...	0 to 10	" 20	0·5 to 1·5	
		{ Rich.....	0 to 10	" 20	1·5 to 5·0	
	Pure.	{ Poor.....	0	Above 99	0 to 0·5	None.
		{ Intermediate...	0	" 98	0·5 to 1·5	"
		{ Rich.....	0	" 94	1·5 to 5·0	"
	Humus.	{ Clayey.....	Above 50	Above 20	Above 5·0	The
		{ Loamy.....	30 to 50	" 20	" 5·0	Remainder.
		{ Sandy.....	20 to 30	" 20	" 5·0	"
VIII. HUMUS SOILS. Containing more than 5 per cent. of Humus.	Soluble mild Humus.	{ Clayey.....	Above 50	With or without Lime.	Above 5·0	"
		{ Loamy.....	30 to 50		" 5·0	"
		{ Sandy.....	20 to 30		" 5·0	"
	Insoluble carbonized or acid Humus.	{ Clayey.....	Above 50	With or without Lime.	Above 5·0	"
		{ Loamy.....	30 to 50		" 5·0	"
		{ Sandy.....	20 to 30		" 5·0	"
	Insoluble fibrous vegetable matter.	{ Bog and Peat Earth.	With Lime. Without Lime.		Above 5·0	"
" 5·0					"	

I. *Argillaceous Soils*, commonly called clay soils, contain above 50 per cent. of clay, and not more than 5 per cent. of lime.

Before treating of this class of soils, it will be necessary to explain what is meant by the term clay. This substance is a combination of silica with alumina; the proportions of these vary in different sorts of clay; thus, in one clay there may be 40 per cent. of alumina, the remaining 60 per cent. being silica, together with some other substances; whilst in another sort of clay, there may be only 30 per cent. of alumina, and nearly 70 per cent. of silica. Clay is chiefly characterized by its plasticity and softness to the touch. According to Schübler, pure clay does not effervesce with acids; diffuses, when breathed upon in a dry state, a strong earthy odour; adheres to the tongue; quickly absorbs water, oils, and fatty substances; it remains, for a certain time, lightly suspended in water, which it renders

muddy, but from which it perfectly separates again, by subsidence when at rest. Of this water it retains, in its finer state, from 70 to 71 per cent., without allowing it to drop away from it; in a compact and moderately moistened state, water penetrates but slowly into its interstices; it dries up slowly, and in so doing, shrinks into a smaller space, leaving many cracks and fissures throughout its substance; it readily takes up humus and humic acid in considerable quantities; these seem to combine with it, partly in a chemical manner, and partly through adhesion in a physical one, in consequence of which it remains for a long time fertile, after it has once been properly penetrated by humus-particles and other earths, which communicate to it the requisite lightness for cultivation.

Besides the above constituents, various other substances incidentally occur in clay. These principally consist of oxide of iron,

sand, free silica, and often of lime, magnesia, oxide of manganese, potash, and soda. Clay, which has been dried in the sun, always contains a certain amount of combined water, varying from 5 to 15 per cent., and which can only be driven off at a red heat. The colours which the varieties of clay assume, are generally owing to the presence of iron in different states of oxidation. Thus, the brown colour results from the protoxide of iron, the red from the peroxide, and the greenish and blue from the hydrated protoxide.

Clay soils are unfitted for the generality of garden productions till improved by draining, liming, trenching, long dung, ashes or sand. When so improved, if rendered sufficiently porous, they become very productive, and are not liable to be so soon exhausted as other kinds of soils.

Analyses of Clay Soils near Cirencester, by Dr. Voelcker.

	No. 1.	No. 2.	No. 3.
Water, driven off at 212° Fah.	5·539	...	...
Organic matter and water of combination.....	3·621	3·38	6·11
Oxides of iron,.....	3·070	8·82	8·34
Alumina,.....		6·67	
Carbonate of lime,.....	·740	...	...
Lime,.....	...	1·44	·41
Magnesia,.....	·605	·92	1·49
Potash,.....	·269	1·48	·65
Soda,.....	·220	1·08	...
Phosphoric acid,.....	·386	·51	·04
Soluble silica,.....	1·450	72·83	80·69
Insoluble silicates (fine clay),	84·100		
Chlorine and sulphuric acid,...	traces.	traces.	traces.
Carbonic acid and loss,.....	...	2·87	2·27
	100·000	100·00	100·00

II. *Loamy Soils.*—These contain not more than 50, nor less than 30 per cent. of clay; of lime and humus, there may be less, but not more than 5 per cent. of each, and the remainder, sand and other matters. The above would constitute a strong loam, which, properly drained, deeply trenched, and manured where the quantity of humus is found to be deficient, would form a good soil for orchards; and when soils of this kind approach to the sandy loams, they may be converted into excellent garden soil.

III. *Sandy Loams.*—These contain not more than 30, nor less than 20 per cent. of clay; and not more than 5 per cent. of lime, or of humus. Sandy loams, in general, form excellent garden soils, producing, when properly manured, heavy crops of vegetables, and earlier than the strong loamy soils. Fruit-

trees do well in this kind of soil, provided it is not too much impregnated with oxide of iron.

IV. *Loamy Sands* contain not more than 20, nor less than 10 per cent. of clay, and not more than 5 per cent. of lime, or of humus. They are too light for fruit-trees, although, when deep and on a good subsoil, these may be made to succeed by adding compost, and by taking care that the roots are duly supplied with water. Such kitchen garden crops as potatoes, carrots, and turnips, succeed well in these soils. They are desirable for early crops.

V. *Sandy Soils.*—These contain, at least, 80 per cent. of silicious sand. They are extremely porous, and afford a ready passage to air and water, as well as to the roots of plants. Their colour is variable, being white, yellow, brown, or red, according to the quantity of oxide of iron which they contain. When they consist of sand and gravel, with little or no humus, alumina, or lime, they are extremely barren; but with as much as from 3 to 5 per cent. of humus, they are very suitable for the growth of some crops, such as potatoes, turnips, and carrots.

By the addition of clay or marl, soils of this class are rendered more compact, and permanently improved. When so treated, they are enabled to retain moisture for a longer period, and the manuring principles are prevented from being too readily washed away or evaporated.

Analyses of Sandy Soils, by Dr. Sprengel.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Silica & quartz } sand, . . .	96·000	92·014	90·221	98·8	96·7	94·7
Alumina, . . .	·500	2·652	2·106	·6	·4	1·6
Oxides of iron, . .	2·000	3·192	3·951	·3	·5	2·0
Oxide of man- } ganese, . . .	trace	·480	·960	...	...	...
Lime, . . .	·001	·243	·539	·1	trace	1·0
Magnesia, . . .	trace	·700	·730	·1	·1	trace
Potash, . . .	"	·125	·066	...	trace	·1
Soda, . . .	"	·026	·010	...	"	...
Phosphoric acid, . .	"	·078	·367	...	"	trace
Sulphuric acid, . .	"	trace	trace	...	"	...
Chlorine, . . .	...	"	·010	...	·1	...
Organic matter } (humus), . . .	1·499	·490	1·040	...	2·2	·5
	100·000	100·000	100·000	99·9	100·0	100·0

No. 1.—Barren sandy soil, near Wattingen, in Luneburg.

No. 2.—Sandy soil, near Drakenburg, on the Weser, producing very bad red clover.

No. 3.—Near Gandersheim, in Brunswick, growing luxuriant crops of pulse.

No. 4.—Very barren drift-sand, near Meppen.

No. 5.—Barren sandy soil, near Aurich, East Friesland.
No. 6.—Fertile sandy soil, near Brunswick, producing luxuriant crops of lucerne, sainfoin, lupins, poppies, &c.

VI. *Marly Soils*.—These contain more than 5, but not more than 20 per cent. of lime. According as they partake of the constituents of other soils, they are termed clay marls, loamy marls, and sandy marls. Marly soils are intermediate between calcareous and clay soils; they are not so retentive of moisture as the latter, neither are they so porous as the generality of the former.

Clay marls, containing more than 50 per cent. of clay, are too stiff for gardens. Loamy marl, if rich in humus, is an excellent soil, suitable for fruit-trees, and capable of bearing heavy crops. Sandy marls are good for early crops, especially if darkened in colour by humus.

Analysis of a Marly Soil, from the neighbourhood of Cirencester, by Dr. A. Voelcker.

Organic matter and water of combination,.....	10.50
Oxide of iron and alumina.....	11.92
Carbonate of lime.....	19.92
Carbonate of magnesia,.....	25
Potash,.....	62
Soda,.....	09
Phosphoric acid,.....	38
Sulphuric acid,.....	04
Soluble silica,.....	13.45
Insoluble silicates and sand,.....	42.07
Loss,.....	75
	<hr/> 100.00

VII. *Calcareous Soils*.—These contain more than 20 per cent. of lime, and, according to the amount of clay or sand which they contain, they are called calcareous clays, calcareous loams, and calcareous sands. Soils in this class vary much in their nature and productiveness, according to the proportions of their constituents; and when a considerable quantity of clay and sand enters into their composition, they are generally fertile. Calcareous soils, when light coloured, do not readily become heated by the sun's rays, in consequence of the latter being reflected, and, therefore, they are not so well adapted for very early crops. This defect is remedied by the addition of such soils and manures as tend to darken the colour. On the other hand, it may be observed, that, when once heated, they do not so readily cool as soils of a darker hue, because heat is radiated with less rapidity from light than from dark surfaces.

Analysis of a Calcareous Soil, from Southrop, Gloucestershire, by Dr. A. Voelcker.

Lime,.....	52.33
Magnesia,.....	31
Oxide of iron and alumina,.....	2.86
Phosphoric acid,.....	traces.
Sulphuric acid,.....	„
Silica,.....	26
Carbonic acid,.....	44.70
	<hr/> 100.46

VIII. *Humus Soils or Vegetable Moulds*.—

All soils containing more than 5 per cent. of humus, no matter what their other composition may be, are termed vegetable moulds. From this it results, that soils of very opposite natures are comprised in this class, to which the rich and productive garden moulds, and the poor and barren peat or bog, alike belong. Vegetable moulds are called clayey, loamy, or sandy, according to the amount of clay or sand they contain; and when the vegetable matter has been converted into the substance known as peat, the soil is termed peaty or boggy.

As peat is extensively employed in gardens for the growth of American and other plants, it will be necessary to give some account of its nature and formation. “The matter of the soils of this class is dark in its colour, spongy in its texture, either entire or in a state of partial decay. It is generally tough and elastic; and, when dried, it loses much of its weight and becomes inflammable. These, the most observable characteristics of the soils termed peaty, will distinguish them, in their natural state, from every other; and even when they shall have been greatly improved by culture, enough of their original characters will remain to make them known.

“Peat consists of vegetable matter which has undergone a peculiar change. Under a degree of temperature not sufficiently great to decompose the plants that have sprung up upon the surface, these plants accumulate; and, aided by a certain degree of humidity, are converted into peat, which is either found in strata upon the surface of plains, or accumulated in great beds on the tops and acclivities of mountains, or in valleys, hollows, and ravines, successive layers of plants being added to the mass, under circumstances favourable to its production. Water is a necessary agent in its formation; and we may believe, too, a peculiar temperature, since it is only in the

cold and temperate, and not in the warmer regions of the earth, that true peat is found to be produced. The plants which form it have not entirely decayed, but still retain their fibrous texture; and, from the action of certain natural agents, have acquired properties altogether distinct from those they possessed in their former condition. They have now formed a spongy, elastic, inflammable body; and so different from the common matter of vegetables, as to be highly antiseptic.

"The plants whose progress towards decomposition has been thus arrested are very various. Over the greater part of the surface of the primary and transition districts of colder countries the peat is chiefly formed of heaths, mixed with the mosses, and cryptogamic plants which had grown along with them. Sometimes the peat has been formed in swamps and lakes, and, at other times, the humidity of the climate has been sufficient to form it into a continued bed, covering the whole surface of the country.

"But vegetable matter which accumulates on the surface undergoes various degrees of change, and hence peat differs in its properties according to the temperature and moisture of the climate. Sometimes the vegetable matter on the surface forms a stratum of dry turf, clastic and inflammable, but less truly peaty than that which is formed where there is abundance of water. Such is the peat formed on the silicious sand and poorer chalks of some parts of England, and on the heathy sands of the north of Germany. Under other conditions of climate, again, the vegetable matter which accumulates on the surface proceeds through further degrees of decomposition, and forms a mass eminently suited to the growth of plants. Such is the vegetable soil formed in the woods of America by the falling of leaves. This substance is wholly different from the true peat, which resists decomposition, and which covers so great a part of the surface of Scotland and Ireland."—(Low's *Elements of Practical Agriculture*.)

Many kinds of vegetables, such as potatoes, turnips, carrots, cabbages, and celery, will grow very well on peaty soils, when improved, as will also quinces, medlars, black currants, mulberries, strawberries, and raspberries. Peaty soils are not, however, eligible for gardens, except for the growth of certain plants, such as rhododendrons, azaleas, and kalmias, for which peat is almost indispensable.

Analyses of Fertile and Infertile Vegetable Moulds.

	MULDER.		DR. SPRENGEL.			
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Organic matter and combined water (humus)	12.000	12.502	10.90	16.70	37.00	90.44
Potash,	1.026	1.430	.01	.06	trace	.01
Soda,	1.972	2.069				
Ammonia, . . .	.060	.078	...	...	...	trace
Lime,	4.092	5.096	1.00	.13	.32	.55
Magnesia, . . .	.130	.140	.20	.03	.31	.08
Peroxide of iron, Protioxide of iron	9.039	10.305	6.30	.64	.52	.12
Protioxide of manganese, }	.350	.503				
Alumina, . . .	.288	.354	...	...	...	...
Alumina, . . .	1.364	2.576	9.30	.78	.45	.63
Phosphoric acid, .	.466	.324	.13	.11	trace	.02
Sulphuric acid, .	.896	1.104	.17	.02	..	.19
Carbonic acid, . .	6.085	6.940	...	...	...	...
Chlorine,	1.240	1.382	trace	.01	trace	trace
Soluble silica, . .	2.340	2.496	71.80	81.50	61.57	7.96
Insoluble silicates (clay), }	57.646	51.706				
Loss,	1.006	.935	.19	.02	...	...
	100.000	100.000	100.00	100.00	100.17	100.00

Nos. 1 and 2.—Fertile soils of a tract of land in North Holland (between Nieuwe-sluis and Aertswonde), gained by embankment from the sea.

No. 3.—Rich vegetable mould, near Wayer, on the Weser, in Germany, flooded by the river.

No. 4.—Poor sandy mould, near Brunswick.

No. 5.—Very infertile peaty soil, near Aurich, in East Friesland.

No. 6.—Boggy, very sterile land, near Giffhorn, in Germany.

II.—ON DETERMINING THE NATURE OF SOILS.

The nature of soils may be determined by ascertaining their chemical composition and their physical properties, and by observing the vegetable productions which grow upon them.

By chemical analysis the composition of a soil can be ascertained; but, as the analysis of a soil is an operation of great nicety, and which can only be performed by an experienced chemist, it is better in all cases to send a sample of the soil to such a person to be properly analyzed. Nevertheless, a pretty good idea of the quality of a soil may be formed by knowing the proportion in which clay, lime, sand, and organic matter exist in it. By this knowledge, also, soils may be referred to the particular class to which they belong; and, as the analysis requisite for this purpose may be made by any one possessed of moderate abilities, we extract the following simple mode of proceeding from an excellent little work, by Mr. Martindale (*The Farmer's and Gardener's Guide to the Analysis of Soils and Manures, and to the Practical Application of Agricultural Chemistry*), with which a fur-

ther acquaintance would prove highly beneficial to any who may wish to pursue investigations of this nature:—

“In order to assign a soil to its peculiar class, proceed as follows:—First, take care to select a fair sample from the field, not rejecting any small stones that may be in it; next expose it freely to the air, till it becomes dry at ordinary temperatures. Process 1st—Weigh out a quantity of this air-dried soil—say 200 grains—and introduce it into a short test tube or suitable vessel, and heat in a saline or oil bath, at 300° Fah., till it cease to lose weight. The loss of weight is then carefully ascertained. This, although not involved in the classification, is, in itself, an interesting point. The percentage of water being known of a portion of air-dried soil, corresponding to 100 or 1000 parts of thorough-dried soil, can be used in any subsequent operation. Process 2d—Take 200 grains of dried soil, and mix it in a Florence flask, with 4 or 5 oz. of water, and boil. Then allow the contents of the flask to remain quiet for about ten minutes. If any sandy matter subsides, then pour off the supernatant fluid, and add more water, until nothing but sand seems left: dry, and weigh it. Half this weight is equal to the percentage of sand in the moist soil. Process 3d—In order to determine the amount of organic matter, take 400 grains of the *thorough*-dried soil (freed of water after the manner just stated), and transfer it into a porcelain or platinum capsule or crucible, and heat it to redness in the furnace, or over a spirit lamp; allow it to remain red hot for about ten minutes, then let it cool. Determine the loss of weight by weighing the soil remaining in the capsule. The loss since the first weighing is organic matter: divide the loss by 4, and the quotient is equal to the percentage of organic matter. Suppose the loss to be 40 grains, then $40 \div 4 = 10$ grains, or 10 per cent. of organic matter. Process 4th—Take that portion of soil which remains after ignition and transfer it into an evaporating dish or precipitating jar, and mix it with 5 fluid oz. of hydrochloric acid; stir the whole mixture well, and allow it to remain for two or three hours. Bring the contents of the dish or jar on to a weighed filter; and, when the liquid portion has passed through, wash the filter several times with pure water; dry the filter and its contents at 300° Fah.; weigh the contents, and the loss of

weight reckon as lime. If the loss in this process amount to 46 grains, then $\frac{46}{4} = 11.5$, or $11\frac{1}{2}$ grains, or $11\frac{1}{2}$ per cent. of lime. Process 5th—Take the contents of the filter paper and carefully brush them off into a tall narrow test jar; then carefully mix them with a convenient quantity of water, say 4 oz.; stir the whole well, till the soil is completely mixed and diffused through the water. After this is done, allow it to settle till the sand or coarser parts have completely subsided; which, in a general way, will take place in a minute or two. The portion still held in suspension pour off into another vessel, and filter it afterwards. Pour a second portion of water, and on the part subsided, stir the whole well up, and again allow the coarser parts to settle; after which pour off the suspended part for filtration. Continue this process until only sand, and matters incapable of remaining suspended in water for a short time remain. Collect the suspended matter on a weighed filter, dry it at 300° Fah.; weigh the contents thereof, and regard the weight as clay. Suppose the weight to be 130, then $\frac{130}{4} = 32.5$, or $32\frac{1}{2}$ grains; hence the soil contains $32\frac{1}{2}$ per cent. of clay.”

By means of chemical analysis we may ascertain what substances entering into the food of plants are present or not in the soil; and we may so be enabled to find out the cause of infertility, and the way in which this may be remedied. Nevertheless an analysis may show that a certain soil contains all the substances required by plants for food, and yet that soil may be barren, either in consequence of its constituents being so combined as to be incapable of being taken up by the roots of plants, or from some other cause, such as the soil being saturated with water, and the free action of the air thereby prevented. We may therefore conclude, that, although chemical analysis may be and is of great assistance in determining the nature of soils, yet it is not safe to trust to it entirely, without taking into consideration their physical properties, which are also of great importance.

The physical properties of soils to which our attention should be principally directed, are the state of division of the soil, its density, its power of absorbing and retaining moisture and gases, and its power of absorbing heat. The following methods of examining these properties are from the article “Analysis,” in Morton’s *Cyclopedia of Agriculture*:—

In order to ascertain the state of subdivision of a soil, "One or two lbs. of the soil should be collected from two or three parts of the field—provided that it be all of the same character—the separate portions should be well mixed, and then slightly dried. Two or three lbs. of the mixture (of which the lumps are gently broken up) are thrown upon a sieve, which will allow portions smaller than a pea to pass through its meshes; the relation in weight between the separated portions is then ascertained. The finer portion is now again gently broken down, either by a common rolling pin, on a deal table, or in a wedge-wood mortar. It is then sifted through a very *fine* wire gauze sieve; the portion which does not pass is gently rubbed a second time, and returned to the sieve; the relation in weight of these portions is thus found. By these manipulations, the soil is separated into three distinct portions, which may be thus designated:—

- "1. Stones and pebble.
- "2. Coarse sand and gravel.
- "3. Fine soil."

Nos. 1 and 2 should then be tested with hydrochloric acid, when, if they contain lime, they will effervesce. In the subsequent operations only the fine soil is used.

To ascertain the density of a soil, both the specific gravity and the weight of a certain measure of the soil should be found.

"The specific gravity or relative weight of soils is perhaps of some importance; but we must confess that it would seem to us of little practical application. It is not a datum capable of elucidating the chemical composition of the soil, although it really depends on that constitution; whilst it does not indicate the physical condition of the soil, inasmuch as it takes no account of the interstices upon which depends its porosity. The absolute weight of a soil is, however, some indication of its permeability to air and moisture, when the weight of a *given measure* is obtained as well.

"The specific gravity of a soil may be roughly estimated thus:—A delicate glass bottle, with a long neck, is filled with water to a scratch made upon the neck with a file; the bottle with the water in it is then weighed, the water is thrown out, and 200 grains of soil are introduced into the bottle, which is again filled up to the mark with water, and agitated to disengage bubbles of air which may be contained in the soil. On being now weighed

it will be found much heavier than when the bottle was filled with water; the *difference* is the amount by which the soil used exceeds in weight the water it has displaced. Thus, suppose the bottle containing the soil and water, to contain 100 grains more than the bottle when filled with water only, then the 200 grains of soil have occupied the place of 100 grains of water, or the former is twice as heavy as the latter; the specific gravity is then said to be 2; or 2000: water being the standard of comparison, and being considered as 1; or 1000.

"[In conjunction with the specific gravity, it is well to ascertain the weight of a given measure (say an imperial half pint) of the soil; which, with the former quality, affords more information as to its physical properties than either determination alone."

The variation in the weight of a cubic foot of different sorts of soil is exhibited in the following table:—

One cubic foot of dry silicious or calcareous sand, weighs about	110 lbs.
Half sand and half clay, weighs about.....	95 "
Of common arable soil, weighs from.....	80 to 90 "
Of pure agricultural clay, weighs about.....	75 "
Of garden mould, weighs about.....	70 "
Of peaty soil, weighs from.....	30 to 50 "

The property of absorbing moisture from the atmosphere, either in the state of dew or that of aqueous vapour, is an important property, without which, in hot dry weather, plants would perish. This power is, however, possessed by some soils to a much greater extent than by others, and in the most fertile soils it is always found to be greatest.

Sir Humphrey Davy found, that when dried at 212°, and exposed for an hour to an atmosphere saturated with moisture, and at the temperature of 62°, 1000 parts of a

Celebrated soil from Ormstown, East Lothian, gained.....	18 grs.
Very fertile soil from the banks of the river Parret, in Somersetshire, gained.....	16 "
Soil from Mersea, in Essex, worth 45s. an acre, gained.....	13 "
Fine sandy soil from Essex, worth 28s. an acre, gained.....	11 "
Coarse sand, worth 15s. an acre, gained.....	8 "
Soil of Bagshot Heath, gained.....	3 "

The eminent authority above named states, that the soils most efficient in supplying the plant with water by atmospheric absorption, are those in which there is a due mixture of sand, finely divided clay, and carbonate of

lime, with some animal or vegetable matter; and which are so loose and light as to be freely permeable to the atmosphere. With respect to this quality, carbonate of lime and animal and vegetable matter are of great use; they give absorbent power to the soil, without giving it likewise tenacity. Sand, which also destroys tenacity, gives, on the contrary, little absorbent power.

The power of absorbing water is ascertained by exposing a weighed portion of the soil, previously dried at 300° , to the air for a certain number of hours; when again weighed it will be found heavier. This excess of weight, if compared with that of other soils treated in the same way, and under the same circumstances of atmospheric moisture, will exhibit the comparative power which the soil has of attracting moisture from the air.

The power of absorbing gases from the atmosphere is, in general, possessed in the greatest degree by those soils which absorb the greatest quantity of moisture. This property is one of very great importance, more especially as regards carbonic acid and ammonia, which play such important parts in the nutrition of plants. Though the absorption of these bodies appears to be in some measure owing to the porosity of the soil, yet it is almost entirely due to chemical action.

In connection with this subject, we shall here revert to some researches on the absorptive powers of soils, undertaken by Professor Way, who has succeeded in bringing to light facts of the greatest importance.

Mr. Thompson, of Kirby Hall, near York, having discovered, by experiment, that soils possess the faculty of separating ammonia from its solutions; and Mr. Huxtable having found that liquid manure was decolorized and deprived of its smell on being passed through a bed of loamy soil, Professor Way was induced to engage in a series of experiments on the power which the soil has of absorbing manuring substances. The last-named gentleman found, that when weak solutions of caustic ammonia were passed through a bed of soil, the solutions were deprived of their ammonia; that the quantity of ammonia thus absorbed varied according to the strength of the solution employed; and that some soils had the property of absorbing a much greater quantity of this substance than others. Thus, 1000 grains of a soil from the Dorsetshire downs gained from a solution of caustic am-

monia, in one experiment, 3.083 grs. of ammonia; in another, 3.921 grs.; in a third, 3.504 grs.; and in a fourth, 3.438 grs. The difference in the amount absorbed in the above experiments was owing to solutions of different strengths having been used; and Professor Way found that the same soil always absorbs the same quantity of ammonia and other substances, when solutions of the same strength are employed.

One thousand grains of a light-red soil from Berkshire absorbed only 1.570 grains. From this, and numerous other experiments, it is established that the power of absorption is greater in some soils than in others.

It was likewise found, that potash and other bases were also absorbed; 1000 grains of a very tenacious white clay absorbed 1.050 grains of potash from a solution containing 1 per cent. of caustic potash; the alkaline solution being merely left in contact with the clay for twelve hours, and not filtered through it. From this, and other experiments, it appears that the property of absorbing alkalies is not due to filtration, but to chemical combination.

But another most important fact has been elicited; for it was found, that when solutions of the salts of ammonia, and of other alkaline bases, pass through a bed of soil, the salt is decomposed and the base retained by the soil; whilst the acid combines with lime, or some other base, and passes through with the water. For instance, when solutions of sulphate of ammonia were passed through a layer of soil, the ammonia alone was retained, the sulphuric acid, in most cases combined with lime, passing through with the water. Similar changes took place when the muriate, nitrate, and other salts of ammonia, as well as those of potash, magnesia, &c., were employed, the alkali, in every case, being retained by the soil, whilst the acid passed away in combination. That these changes are produced by chemical decomposition is proved by the fact, that the quantity of lime, or other base, combined with the acid and passing through with the water, exactly corresponds with the amount of ammonia, potash, or magnesia retained in the soil.

In the case of solutions of alkaline salts, it was also found that some soils possessed greater powers of absorption than others. Thus, 1000 grains of the light-red soil from Berkshire absorbed from the muriate of ammonia, 1.966 grains of ammonia; 1000 grains

of subsoil clay from Cornwall (coloured red by oxide of iron), absorbed from the muriate of ammonia, '818 of a grain of ammonia; and 1000 grains of a tenacious white clay absorbed from the muriate of ammonia, 2·847 grains of ammonia.

The power which soils have of absorbing various bases, is referred by Professor Way, not to any physical cause, but to the action of a class of salts called double silicates. Before entering further into this subject, it will be necessary to explain what is meant by a double silicate. Now, it is known, that silica, or silicic acid, chemically combines with potash, lime, alumina, &c., forming what are called the silicates of these substances; but these simple silicates have the power of uniting one with another, forming double silicates. For instance, silicate, or alumina, or clay, is frequently united with silicate of lime, thus forming a double silicate. It has been found by Professor Way, that one of the bases contained in the double silicates, may be replaced by another base, with which the silica unites in preference; thus, when the double silicate of alumina and soda is digested with a solution of a salt of lime, the compound becomes the double silicate of alumina and lime, the soda uniting with the acid of the salt of lime.

The order in which the different bases replace each other in the double silicates, has been determined by Professor Way to be as follows—Soda, lime, magnesia, potash, ammonia. For the more perfect comprehension of this, we shall give an instance. In the double silicate of alumina and soda, the soda may be replaced by lime; the compound will then become the double silicate of alumina and lime. Again, the lime in this may be replaced by magnesia, the magnesia by potash, and the potash by ammonia. From this it will be evident, that each base has the power of replacing, in the double silicates, the bases which stand before it in the list; and that this power is possessed by ammonia in the highest degree.

It is by means of the property which the bases have of replacing each other in the class of compounds called double silicates, that ammonia and other alkaline bases are absorbed by the soil; and it must be evident to every one, how much this power of absorption, possessed by different soils, in different degrees, must affect their productiveness, and the benefits which they are capable of deriving from manures.

To discover the power which a soil has of retaining water, "the soil," dried as before, "is placed upon a double filter in a funnel, and water is gently poured upon it until it will take up no more. The superfluous water is allowed to drain off, and the whole is then weighed; the increase of weight is the water which the soil can take up or retain." This property is important; for soils which, as in the case of stiff clays, retain much water and part with it slowly, are cold in consequence of a large amount of heat being expended in its evaporation. Besides this, when the soil is saturated with moisture, the free access of air is prevented, and, consequently, neither germination nor decomposition can be carried on. Other soils again, which allow water to pass too quickly through them, are dried up in hot dry weather, whilst in wet weather their most soluble and nutritious principles are washed away. It must, therefore, be evident, that a fertile soil should neither retain too much nor too little water, and that, in a dry climate, the soil should be capable of retaining more water than in a moist one, such as that of Ireland, and the western side of this island.

It is also useful to ascertain the rapidity with which the soil parts with water; in order to do this, "a weighed quantity of the wet soil is placed in an open place for a given time—say two or three hours; at the end of this time it is again weighed. The amount which has evaporated is thus learned. The result is only of value if made upon other soils at the same time: the comparison should be made with a heavy, stiff clay, and a light almost pure sand; and it must be repeated for every soil that is examined, since the rate of evaporation is dependent upon the temperature and the moisture in the air, which differ at each observation."

The power which the soil has of absorbing heat, when placed in the sun's rays, is of the highest importance. To determine this property, the dry soil should be exposed to the sun, and a delicate thermometer buried in it. Some soils, when thus treated, absorb a much greater amount of heat than others, and this depends, to a great extent, on the colour of the soil, as will be presently seen.

"In general, soils that consist principally of a stiff white clay are with difficulty heated; and being usually very moist, they retain their heat only for a short time. *Chalks* are simi-

lar in one respect, that they are difficult to heat; but being drier, they retain their heat longer, less being consumed in causing the evaporation of their moisture.

"A black soil, containing much soft vegetable matter, is most heated by the sun and air; and the coloured soils, and the soils containing much carbonaceous matter, or ferruginous matter, exposed under equal circumstances to sun, acquire a much higher temperature than pale-coloured soils.

"When soils are perfectly dry, those that most readily become heated by the solar rays, likewise cool most rapidly; but I have ascertained by experiment, that the darkest coloured dry soil (that which contains abundance of animal or vegetable matter; substances which most facilitate diminution of temperature), when heated to the same degree, provided it be within the common limits of the effect of solar heat, will cool more slowly than a wet pale soil, entirely composed of earthy matter.

"I found that a rich black mould, which contained nearly one-fourth of the vegetable matter, had its temperature increased in an hour from 65° to 88°, by exposure to sunshine; whilst a chalk soil was heated only to 69° under the same circumstances. But the mould, removed into the shade, where the temperature was 62°, lost, in half an hour, 15°; whereas, the chalk, under the same circumstances, had lost only 4°.

"A brown fertile soil, and a cold barren clay, were each artificially heated to 88°, having been previously dried; they were then exposed in a temperature of 57°; in half an hour the dark soil was found to have lost 9° of heat; the clay had lost only 6°. An equal portion of the clay containing moisture, after being heated to 88°, was exposed in a temperature of 55°; in less than a quarter of an hour, it was found to have gained the temperature of the room. The soils, in all these experiments, were placed in small tin-plate trays, 2 inches square, and $\frac{1}{2}$ inch in depth; and the temperature ascertained by a delicate thermometer."—(Davy's *Elements of Agricultural Chemistry*.)

The nature and quality of the soil may frequently be determined, with a considerable degree of accuracy, by the vegetation which it naturally produces; and this should not be overlooked, although a good analysis may also have been made. The following plants have been observed to grow naturally on differently constituted soils:—

Argillaceous.—Tussilago Farfara, Potentilla Anserina, Potentilla argentea, Orobus tuberosus, Lotus major.

Calcareous.—Veronica spicata, Campanula glomerata, Onobrychis sativa, Lithospermum officinale, Nepeta major.

Silicious.—Silene anglica, Arenaria rubra, Veronica verna.

Peaty.—Vaccinium Myrtillus, Vaccinium uliginosum, Oxycoccus palustris, Calluna vulgaris, Erica cinerea, Erica Tetralix, Spargula subulata, Tormentilla erecta, Empetrum nigrum, Eriophorum vaginatum, polystachyon, and angustifolium, Sphagnum obtusifolium, Sphagnum acutifolium; and Rumex Acetosella indicates a peaty iron soil.

Very dry soil.—Galium verum, Galium saxatile, Aira præcox, Aira caryophyllea, Aira cristata, Hieracium Pilosella, Arenaria rubra, Thymus Serpyllum, Trifolium arvense.

Wet infertile soil.—Juncus squarrosus, Juncus acutiflorus, Cnicus palustris, Pinguicula vulgaris, Triglochin palustre, various species of Carex, Hippuris vulgaris, Epilobium tetragonum, Lythrum Salicaria, Ranunculus Lingua, Ranunculus Flammula.

Wet, but not necessarily infertile, soil.—Poa aquatica, Alopecurus geniculatus, Veronica Beccabunga, Juncus conglomeratus.

Fertility.—Cnicus lanceolatus, Urtica dioica, Stellaria media, Dactylis glomerata, Poa trivialis. And where trees, such as the elm, oak, lime, beech, and walnut grow vigorously, we may be assured the soil is good.

Cold subsoil.—Of this, Equisetum arvense is peculiarly indicative.

The vegetation supported by the surface layer of soil is not always to be taken as completely indicative of the degree of fertility which the land possesses. There are instances where the surface soil affords only a poor vegetation, and yet deeply-rooting forest-trees thrive remarkably well. This has been observed to be the case where a thin layer of soil rests on a pan of a compact, retentive, clayey substance, under which is a considerable depth of strong rich loam. Into this the strong roots of trees can penetrate and find abundant nourishment; whilst those of herbaceous plants cannot do so, and therefore only such of them appear as can exist in the poor thin topstratum.

As gardens are generally formed where the ground has been under cultivation, and where either trees or hedges are frequently on the

site, the growth of these should be observed. If the oak or elm thrive well, there is every probability that the soil is capable of being adapted for a garden; and where the common hawthorn makes vigorous shoots, there fruit-trees, such as the apple, pear, plum, and cherry, will also succeed, and indeed, we may say, all other fruit-trees likewise, so far as the soil is concerned.

III.—SUBSOIL.

The bed on which the upper layer of soil rests is called the subsoil, and the nature of this is of great importance as regards cultivation; for however good the upper soil may be, if a bad subsoil be within reach of the roots of plants, they will be injured in consequence. Therefore, a knowledge of subsoils becomes necessary, in order that a good one may be chosen where gardens are to be formed; or, if circumstances determine their site to be where a bad subsoil exists, the latter must either be removed to some extent, or ameliorated as much as possible.

The subsoil may consist of rock, entire or in a broken state, of soil differing more or less in its nature from the surface layer, or it may be a mixture of stones and different kinds of earth. Hence, subsoils are found to be exceedingly variable in their elementary composition. They vary, likewise, in their distance from the surface, according as the layer of soil above them is of greater or less thickness. Sometimes, within a certain area, the surfaces of the soil and subsoil form parallel planes, in other cases, the upper surface is even, but that of the subsoil irregular; and, on the other hand, the surface may be uneven, whilst the subsoil is nearly a uniform plane. It is desirable, that, supposing the soil of a garden were entirely removed, the subsoil should not exhibit an undulating surface, especially where such subsoil is retentive of moisture; for, in that case, water, instead of passing off with regularity, is liable to drain too quickly from the higher parts, and to be retained longer in the hollows than is favourable to vegetation.

In some cases, the stratum of subsoil differs but little from the soil above it. For example, the subsoil may consist of a fine yellow sandy loam; the soil above may be the same kind of sandy loam, but less compact from its position, and from cultivation and exposure to

the weather, whilst its colour is rendered dark by decayed vegetable matter. Here the dark colour of the top soil and mixture with humus distinguishes it from the subsoil. The composition of the subsoil is generally more inorganic than that of the upper layer of soil.

The stratum of subsoil is, in many cases, of such a nature that more or less of it may be trenched to add permanently to the depth of the soil. Sometimes a subsoil forms a hard pan, almost impenetrable to water and to the roots of plants. Under this, however, there is occasionally even a rich loam or marl. In this case it is evident that the intermediate pan should be broken up; or if, independent of its hardness, its composition is essentially bad, it should be removed if circumstances will permit. A good subsoil should be free from any injurious quantity of metallic oxides, or other matters deleterious to plants; for if it contain such, and if they cannot be corrected, fruit-trees will become unhealthy when their roots come in contact with these substances. The subsoil should, therefore, be tested chemically before a garden is formed upon it. This, in fact, should be the first proceeding in determining whether a subsoil, with reference to the formation of a garden, is eligible or not. Assuming that the subsoil is free from any substance of a character specifically deleterious, it may, notwithstanding, be objectionable on account of its mechanical properties. It may be too compact, or, on the contrary, too loose. When it is so compact that water cannot pass through it, the soil above it is, in consequence, saturated at times with water, a condition highly injurious to the roots of most plants. On the other hand, the subsoil may be too porous, so that the rain water soon passes downwards out of the reach of the roots of plants, carrying with it, at the same time, a large proportion of the nutritive principles of the soil and manures. It may here be observed, that a subsoil too porous for a locality in which little rain falls, may be that which is just proper for a wet district. In some places a loamy stratum lies under the black soil. Where such occurs in localities having only an average of about 24 inches deep of rain in the year, fruit and other trees are apt to evaporate the moisture in the loam, rendering it so dry that the roots become deprived of sufficient moisture for the support of the tree and its fruit.

From the above, it is evident, that the nature of the subsoil ought to be well ascertained as regards its good or bad qualities in the first instance; then its property of retaining moisture; and, finally, its position with reference to the surface level, or inclination, as the case may be. With regard to the first of these investigations, if the subsoil is of a deleterious nature, it will be advisable to avoid forming a garden over it if there is any choice; for a subsoil which is radically bad cannot be effectually remedied. But the compactness of the stratum can be increased or diminished as may be found necessary, by breaking up and admixture; and the level of the subsoil can be regulated to correspond with any required plane by mechanical means.

IV.—IMPROVEMENT OF SOILS.

Most soils require improvement in order to adapt them for gardens. The means by which this may be effected, are—

- 1st. Draining.
- 2d. Alteration of the subsoil.
- 3d. Increasing the depth of the soil.
- 4th. Alteration of its texture and constituent parts.

The first consideration should be the condition of the soil as regards moisture, for infertility may be solely owing to superabundance of water. The remedy for this is draining; and that being accomplished, other improvements can then be determined on with more precision; for some soils after draining are friable, whilst others harden, and require to be divided by mechanical operations, or by these together with corrective admixtures. When the soil is so circumstanced with regard to moisture as to be generally saturated, few garden plants can thrive in it. Those only of an aquatic nature can endure to have their roots in soil which is always completely soaked with water. But it is here necessary to mention some properties of water which render draining of vast importance as regards increasing the temperature of the soil. They are the well-known properties that water at about 40° is heavier than at any other temperature; that from this point it becomes lighter and lighter as its temperature ascends, and also as it descends, until it assume the form of ice; hence warm water, as well as ice, will float on cold. Even boiling water may be gently poured on cold water without the latter being

heated, excepting a very little at the surface. Now, if the soil be saturated with water colder than that of the summer rains, these rains cannot descend to warm the ground where the roots of plants ought to penetrate. But when the cold water is drawn off below, by proper drainage, the warmer can percolate downwards and communicate its heat to the soil, rendering it congenial to vegetation. In proof of this we may adduce the following observations made by us, and published in the *Journal of the Horticultural Society of London*:—

“It has been ascertained that the specific gravity of water is greatest at a temperature between 39° and 40° Fah., therefore, in any quantity of water not of uniform temperature, that which is 39° or 40°, or, if hotter or colder, that which is nearest to the above, will always be at the bottom; it will not be displaced by the addition of a quantity of the temperature of 60°, nor will the two mix so as to acquire a common temperature without mechanical force. Hence, if a retentive soil is saturated with snow-water, or that from rain of about 40°, such water will not be displaced by lighter, warmer rains. The water derived from the latter must run off by the surface, or stand exposed to the cooling effects of evaporation: in either case its heat is lost without benefiting the soil. The only remedy is to drain deeply; the coldest water, because the heaviest, will then be the first to move, and the pores of the soil, which it previously occupied, will be filled with air, except when the latter is partially displaced by the descent of rain-water, which can then pass freely through spaces no longer exclusively occupied by colder, denser water.

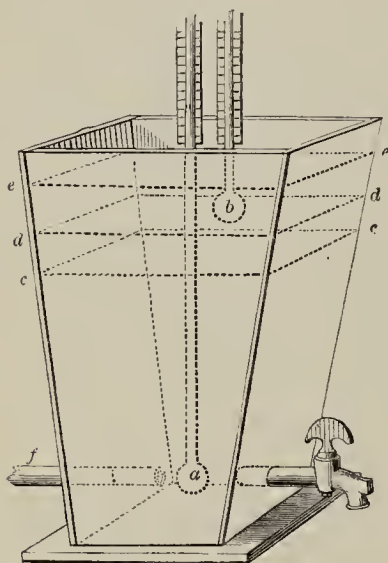
“It is shown by Mr. Parkes, in his *Essay on the Philosophy of Drainage*, that in draining the Red Moss, near Bolton-le-Moors, the thermometer in the drained land rose, in June, 1837, to 66° at 7 inches below the surface, while in the neighbouring water-logged land it never rose above 47° at any time throughout the year. From within 7 inches of the surface, to the depth of 30 feet, the bog in its natural state maintained, in winter and in summer, an invariable temperature of 47°. This, it may be remarked, is about the mean atmospheric temperature of the year in that locality, and the difference between the hottest and coldest months is there 24° or 25°; but it must be inferred from the uniformity

of temperature in the saturated undrained land, that summer rains are ineffectual as regards the communication of heat downwards, and that on such land the intensity of the sun's rays is lost.

"The fact that heat cannot be transmitted downwards through water is well known; but that it is as impossible to heat saturated soil downwards should be also familiar to every one engaged in either horticultural or agricultural pursuits. Some experiments are detailed in the *Gardeners' Chronicle*, 1849, p. 35, by which it is proved that a mixture of peat and water, constituting an artificial bog, could not be heated at a foot below its surface by pouring a quantity of boiling water upon it. I have recently made a similar experiment with saturated yellow loam; and as some may wish to repeat these experiments for their own satisfaction, I shall here state the mode of proceeding and the results.

"*Experiment No. 1.*—A square box was made of the form represented by the annexed diagram (Fig. 42), 18 inches deep, 11 inches

Fig. 42.



wide at top, and 6 inches wide at bottom. It was filled with peat, saturated with water to *c*, forming to that depth ($12\frac{1}{2}$ inches) a sort of artificial bog. The box was then filled with water to *d*. A thermometer, *a*, was plunged, so that its bulb was within $1\frac{1}{2}$ inch of the bottom. The temperature of the whole mass of peat and water was found to be $39\frac{1}{2}^{\circ}$ Fah. A gallon of boiling water was then added; it raised the surface of the water to *c*. In five minutes the thermometer, *a*, rose to 44° , owing to conduction of heat by the ther-

mometer tube and its guard. At ten minutes from the introduction of the hot water, the thermometer, *a*, rose to 46° , and it subsequently rose no higher. Another thermometer, *b*, dipping under the surface of the water at *e*, was then introduced; and the following are the indications of the two thermometers at the respective intervals, reckoning from the time the hot water was supplied:—

	Ther. <i>b</i> .	Ther. <i>a</i> .
20 m.....	150°	46°
1 h. 30 m.....	101°	45°
2 h. 30 m.....	$80\frac{1}{2}^{\circ}$	42°
12 h. 40 m.....	45°	40°

The mean temperature of the external air to which the box was exposed during the above period was 42° , the maximum being 47° , and the minimum 37° .

"*Experiment No. 2.*—With the same arrangement as in the preceding case, a gallon of boiling water was introduced above the peat and water, when the thermometer, *a*, was at 36° , in ten minutes it rose to 40° . The cock was then turned for the purpose of drainage, which was but slowly effected, and at the end of twenty minutes, the thermometer, *a*, still indicated 40° ; at twenty-five minutes, 42° ; whilst the thermometer, *b*, was 142° . At thirty minutes, the cock was withdrawn from the box, and more egress of water being thus afforded, at thirty-five minutes the flow was no longer continuous, and the thermometer, *b*, indicated 48° . The mass was drained and permeable to a fresh supply of water.

"Accordingly, another gallon of boiling water was poured over it, and in

3 minutes	the thermometer, <i>a</i> ,	rose to 77°
5	"	fell to $76\frac{1}{2}^{\circ}$
15	"	" 71°
20	"	remained at $70\frac{1}{2}^{\circ}$
1 h. 50	"	" $70\frac{1}{2}^{\circ}$

"In these two experiments the thermometer at the bottom of the box suddenly rose a few degrees immediately after the hot water was added; and hence it might be inferred that heat was carried downwards by the water; but, in reality, the rise was owing to the action of the hot water on the thermometer, and not to its action upon the cold water. To prove this, the perpendicular thermometers were removed; the box was filled with peat and water to within 3 inches of the top, a horizontal thermometer, *f*, having been previously secured through a hole made in the side of the box by means of a tight-fitting

cork, in which the naked stem of the thermometer was grooved. A gallon of boiling water was then added. The thermometer, a very delicate one, made by Newman, was *not in the least affected* by the boiling water in the top of the box.

Experiment No. 3.—Silver-sand was put into the bottom of the box, so as to be a little above the bulb of the thermometer *f*; with the view of protecting it when introduced; the box was then filled with yellow loam as far as *c*. The loam was then saturated with water from the rose of a watering pot. Numerous air bubbles rose when saturation had been nearly effected, the whole surface of the soil being just covered with water: the latter subsided as the air found its way out. The thermometer, *f*, was then introduced, and it soon acquired the temperature of the mass, 45°. A handful of straw was squeezed together, and laid on the top of the soil, to break the force of the hot water, a gallon of which, when boiling, was poured on. The hot water cooled by evaporation, but produced not the least effect on the delicate thermometer *f*, near the bottom of the box. Another gallon of boiling water was added, when the first had cooled down to 100°; but the thermometer, *f*, still indicated 45°.

“Any person can easily make similar experiments. It is best to introduce the thermometer through the side of the box, as at *f*; for, if plunged from the top, the boiling water surrounding a portion of the tube of the instrument expands the fluid, and indicates an elevation of temperature, although none take place in the medium in which the bulb at *a* is situated. There are rules for correcting the expansion which occurs in such cases, but they are very complicated.

“Water expels air and other gases, the food of plants, from the vicinity of the roots; and all agree that, in this respect, it must be considered injurious. It prevents heat from being carried down to the roots; and, when these are chilled, they cannot support a healthy vegetation. Finally, it is more stagnant in summer than in winter. The retentive nature of the soil, where saturation exists, prevents water of any temperature from moving downwards; but the colder will displace the warmer. For example, water at 47°, having possession of a retentive soil in spring, will not change its position, in consequence of the fall of warm rains during summer. Unless

carried off by evaporation, it will remain stagnant during the warm season, and will only give place to winter rains, or those that may supply colder and heavier water than itself. Stagnant water is known to be very pernicious to the health of plants, excepting to that of some species naturally adapted for growing in it. As proof that the roots excrete, it could be told in many cases from the smell of the soil what plant had been growing in it; and, if roots are long in stagnant water, it becomes impure. Want of drainage, therefore, deprives the roots of proper nourishment, subjects them to a chilling temperature, and forces them to absorb a vitiated fluid.”—(*Hort. Soc. Journal*, vol. v. p. 117.)

Well-drained ground may be saturated for a short time after a heavy fall of rain, so that all the interstices are occupied with water; but, as this descends, it is, of course, replaced by air; for, where water finds a passage, air can always follow; and warm air, like that of summer, circulating among the particles of soil, likewise contributes heat.

Many instances could be adduced of the striking effects of drainage in raising the temperature of the soil. In some cases a rise of as much as 15° in summer is stated to have been produced. As previously remarked, Mr. Parkes found that the temperature of the undrained portion of the Red Moss, near Bolton-le-Moors, never rose above 47°, whilst in another portion of the same bog which had been drained, the temperature was found, on a mean of thirty-five observations, to have been raised 10°; on one occasion the thermometer rose to 66°. Hence it appears, that, by draining, we not only free the soil from superfluous moisture, but, at the same time, we greatly raise its temperature. The temperature of undrained land is more uniform than that of drained, for it is nearly the same winter and summer, and approximates to that of the mean annual temperature of the air in the locality. The heat of summer and the cold of winter affect it but a little way below the surface. Drained land, on the contrary, is more accessible to the cold of winter, and to the heat of summer, so that the temperature of the soil corresponds with that of the air, or nearly so, throughout the respective seasons. This is a most important matter; for, however warm and genial the atmosphere may be for vegetation, yet plants cannot thrive if the soil into which their roots penetrate is

much colder than the air during the growing season.

When the soil is drained, rain-water and air have alternately free access to the various substances in the soil. These substances are acted upon by the carbonic acid contained in the rain-water, and by the oxygen of the air, as well as by that dissolved in the water. The carbonic acid seizes upon the lime, potash, and other alkaline matters; and many substances in a low state of oxidation become more perfectly oxidized, and do not act so injuriously on vegetation. Besides the above, many other important chemical changes take place in the soil after it has been freed of superfluous moisture by draining.

When the subsoil is irregular, impervious, or, on the contrary, too loose, it admits of various alterations conducive to the improvement of the soil. If the subsoil is irregular, it is evident that, when the surface soil is levelled, unequal depths of the latter will be the consequence. Some parts are then liable to have too little depth for the roots of plants, whilst others may have more than is necessary; and, if the subsoil be impervious, the water will lodge in the hollows, to the injury of the soil that is likewise there. The surface level, or its inclination, as the case may be, should therefore be ascertained; and with such the upper part of the subsoil should run parallel, or with a gentle slope towards the drains. In changing the position of the subsoil by levelling it trench by trench, attention should be paid to its state of looseness. It should not be left hard in one place and open in another. The whole should be rendered as nearly uniform in this respect as possible.

If some parts of the subsoil are found to be of a nature easily convertible into good soil by working, exposure to the air, and the addition of manure, it may be taken advantage of, and turned up, to add to the thickness of the soil. The portion so dug out may be replaced up to the determined level by subsoil of inferior quality. By these means the soil, in many instances, may be greatly increased in depth, and thus afford more range for the roots of plants. Besides, if the surface soil has been previously manured for a long time, so that it contains too much inert organic matter, the judicious admixture of fresh ingredients is a permanent improvement. Such additions may be made by degrees; for, if too much inorganic matter were brought at once

to the surface, various garden crops would not thrive in the first instance, nor till such time as a sufficient quantity of vegetable matter has been thoroughly incorporated with the recently turned up subsoil. When this, however, has been effected, a fresh portion of subsoil may be trenched up, and ameliorated in a similar manner. In the formation of a new garden, and presuming that the supply of manure is not limited, it is best to trench the ground at once to the proper depth, introducing a large quantity of manure as the operation goes on.

The soil may be too shallow, but, in other respects, not objectionable for that of a garden. Frequently in the vicinity of shallow soils alluvial deposits are to be found. If these can be raised, and laid on the higher thin land till a sufficient depth is obtained, a good soil for a garden may be formed; and, although this must be done at greater expense than making the garden where the alluvial deposits naturally lay, yet it affords the permanent advantage of having a dry basis, and of being more suitable for early crops and for fruit-trees. When the soil raised from alluvial beds is taken from a depth so far below the surface as not to have been previously exposed to the air, it would be improved by being thrown up in heaps, and turned over in dry weather. The depth of the soil may also be increased by trenching, and by the addition of bulky manures.

Any one of the principal ingredients of which soils are composed, namely, sand, clay, lime, and humus, may be found to constitute nearly the whole of a particular soil. Although with the assistance of manures certain plants will grow on such a soil, yet it cannot be considered as proper for a garden till its nature is modified by the admixture of other ingredients.

If the soil is too sandy, the obvious remedy is clay or marl. It would not, however, be advisable to introduce for garden soil a stiff clay, or one that contains objectionable ingredients, such as iron. It should be capable of mixing with sand, so as to form a friable sandy loam, instead of an obstinate mass. By taking a certain quantity of the sandy soil requiring to be improved, for example, a cubic yard, and adding clay from a measured quantity, till a sandy loam of proper tenacity is obtained, the requisite proportions of clay soil can be ascertained.

In the same way strong clays can be corrected by the addition of sand. The tenacity of strong clays need not, however, be reduced by sand till they become of the texture of a sandy loam, as was recommended in the case of too sandy soil. It will suffice if, by admixture of sand, the clay is brought to the state of a clayey loam, because each successive application of manure will tend to render it lighter than before. Clay soils may also be improved by burning. Important mechanical and chemical effects result from burning clay, or at least from subjecting it to a certain amount of heat. The mechanical effects are to render the clay more porous and less tenacious, so that it will readily crumble after exposure to the action of the weather. From its greater porosity, it affords access to air and moisture, and more free passage for the roots of plants. The chemical changes produced by the burning of clay, are greater solubility of its constituents in water and acids; clay slightly burned has been found to contain more than three times the quantity of soluble potash that it does in its natural state. Felspar is an ingredient of clay soils, and it is composed of silicate of potash or soda, and silicate of alumina. By the action of fire the particles of felspar are decomposed, and the potash, existing previously in an insoluble state in the felspar, is set free, and likewise rendered soluble and fit for the nourishment of plants. Many different opinions, however, are entertained on the changes which take place in clay by burning.

When clay is burned, the heat should not be too great; and the burning should be effected by a smouldering process, somewhat resembling that in making charcoal. The clay should never be so far baked as to be reduced to a hard red brick substance; but, on the contrary, the lumps of burned clay should crumble readily.

Calcareous soils are improved by the addition of clay, or of clay and sand, and the proportions may be so regulated as to form a calcareous loam.

Soils in which too much humus exists, may be substantially improved by the addition of sand, clay, or lime; but more especially by all three. Such soils also derive temporary improvement from burning, but it is only temporary. We have seen peat soil so inert that no crop would grow. By burning, one luxuriant crop was produced, sometimes a toler-

ably good second crop, and then the peat soil relapsed into its previously inert, infertile state. Recourse was again had to burning; and a repetition of this system was carried on till the surface of the soil, at first high enough above drainage, was reduced so as to be almost below the available fall. If clay, marl, scourings of ditches, sand, and, in short, any earthy substance different from peat, had been spread upon the surface, instead of burning the latter, the basis of a good, dry, rich soil, would have been formed, excellent, with proper manure, for root crops, such as carrots, turnips, potatoes, &c. Peat generally rests on clay, and when this is the case, on a source of fertility which, if not too deep, may readily be taken advantage of. If the clay become friable from mixture with the peat and exposure to the weather, the basis of a fertile soil is at once established. If it remain too adhesive, it can be easily burned along with some of the peat which rested immediately above it; or without burning, the tenacity of the clay may be reduced with sand. Admitting that some of the peat may be burned with advantage, as in the above case, or perhaps in others, yet we do not approve of that systematic burning of the surface formerly so much in use. Lime is also of great utility in reclaiming peat, as it aids in decomposing the fibre; and it neutralizes the acids which occur in peat.

The texture of the soil is permanently altered by all the preceding modes of improvement; and for a time, by pulverization. By this the requisite degree of friability is secured; air and water can then readily penetrate into the soil, to the benefit of the plants grown upon it. Besides, the roots of most plants cannot penetrate into the hard compact mass, such as the soil usually becomes when unstirred for any considerable time. By pulverization, also, the temperature of the ground is brought nearer to an equality with that of the atmosphere, by reason of air and water penetrating among the particles of the soil, and communicating their heat to it. The means by which pulverization is effected—namely, digging, trenching, forking, and hoeing—will be reverted to hereafter. Another mode of changing the texture of the soil, is by consolidating it by mechanical means, such as rolling and treading. This mode of improvement is only applicable to very light soils, or in particular cases, such as seed-sowing, &c.

CHAPTER VI.

MANURES

All substances which, when added to the soil, increase its fertility, may be considered as manures. These may act either directly, by supplying food to plants, or indirectly, by rendering the substances already contained in the soil available for the nourishment of plants. The necessity of the application of manures is evident; for as plants withdraw certain elements from the soil, the latter would, in course of time, become exhausted if no restoration of these were made.

Manures may be divided into two classes:—

1. Organic manures, or those of vegetable and animal origin.

2. Inorganic manures, or those of mineral origin.

I.—ORGANIC MANURES.

In this class are included all substances of vegetable and animal origin which have the property of enriching the soil, or of rendering to it substances required by plants for food. All vegetable and animal substances used as manure must undergo decomposition before they become the food of plants, for the roots of these only absorb liquids and gases. This change is generally effected to a certain extent before they are applied to the soil; but in the case of green manures, it takes place entirely in the soil. The results of the decomposition of organic manures are the formation of carbonic acid, ammonia, sulphuretted hydrogen, and many other compounds, which are retained in the soil, from which they are taken up by the roots of plants.

Leaves, when thoroughly decayed and reduced to the state of mould, form a sort of manure, which, alone or mixed with soil, or other substances, is eminently suited for the growth of most plants.

Tan.—Old tan is sometimes employed as a manure; but it exercises an injurious action on the roots of plants, and also tends to promote the growth of various sorts of fungi. For these reasons, the advantage of using it appears to be very questionable; and it is a much safer course to dispense with it entirely as a manure.

Peat becomes a very good manure when

formed into a compost with dung. For this purpose the peat, after having been partially dried, is mixed in alternate layers with about an equal quantity of partly decomposed dung. When fermentation takes place, and the temperature of the mixture rises to 95°, it should be turned, after which, some little time before being made use of, the heap should be turned and thoroughly mixed. Peat dried, as in the former case, may also be made up into a compost with quicklime.

Sawdust is not of much value as a manure; it contains only traces of nitrogen, and when mixed with the soil, it does not readily decompose; it should, therefore, be thoroughly rotted before it is applied. By the addition of liquid manure, of which it will absorb a large quantity, its value is greatly increased, and it is then much more easily decomposed.

Rape-dust.—The refuse of rape seed, after the oil has been expressed, is formed into cakes, which are reduced to a powder, forming the manure called rape-dust. Dissolved in urine, rape-dust is much employed in Flanders, and when so treated, it forms an excellent liquid manure. In this country, rape-dust is generally applied as a top-dressing; but it is much more advantageous to dig it in, either unmixed, or together with rotten dung. In dry seasons it is less efficacious than in wet ones; also in dry soils its application is not attended with such beneficial effects as in those which retain a considerable amount of moisture. For turnips, and other root crops, rape-dust is an excellent manure.

Malt-dust principally consists of the radicle and young shoots of barley which has germinated, and which are separated from the malt during the process of drying on the kiln, or, subsequently, by treading and screening. The dust obtained from the kiln is distinguished as kiln-dust, and is not so pure as the other, being mixed with ashes. Malt-dust contains about 4 per cent. of nitrogen; and Professor Johnston found that its ashes contained 36 per cent. of potash and soda, and rather more than 24 per cent. of phosphoric acid. From this it is apparent that malt-dust forms a very good manure. It is frequently used as a top-dressing; but it is more advantageous to dig it in after it has been slightly fermented by the addition of urine to the heap, or to form it into a compost. When the two first methods are employed, it may be applied at the rate of 30 or 40 bushels to the acre. The beneficial

effects of malt-dust are chiefly owing to the formation of ammonia; they are also, to some extent, due to the phosphoric acid, potash, and soda, which it contains. It is rapid in its action, and its good effects become quickly perceptible; but it does not form a manure of much permanence, being chiefly beneficial to the crop to which it is applied.

Sea-weeds, of various kinds, are largely employed as a manure on the coast. This manure is usually applied to the land in a fresh state, as a top-dressing; but it is preferable to dig it in at once. Mixed with earth and dung, it forms an excellent compost. The good effects of sea-weed are of short duration, seldom extending beyond the crop to which it is applied. As it usually contains about 80 per cent. of water, its conveyance to a distance is expensive, and for this reason it is never used far inland. Sea-weeds are frequently burned, and the ashes employed as a manure, for which purpose they are highly esteemed by the inhabitants of Jersey, Guernsey, Normandy, and Brittany. Nevertheless, as the organic matter is destroyed by burning, and, consequently, much of the fertilizing constituents lost, this practice is not to be recommended, although a saving in the expense of carriage is thereby effected.

Green manures.—Plants are sometimes grown specially for the purpose of being dug into the soil, when they are in a green and succulent state, as a manure. This practice is seldom, however, adopted in gardens, or, indeed, wherever the ground is in a high state of cultivation. A much more advantageous plan is to apply the green crop to the feeding of animals, in which way, not only is manure produced, but food as well. The plants usually grown for the purpose of being dug into the soil are those which grow quickly, such as buckwheat and rape. These, when full of juices, are dug in as soon as the flowers commence to appear; for at this stage of their growth the plants soon decompose, and become available for the nourishment of the succeeding crop. There is, however, a class of green manures which is more extensively employed in gardens. These consist of potato haulm, turnip tops, the dressing of cabbages, &c., and which are occasionally dug in when in a fresh state; in general, however, it is much better to make them up into a compost, and decompose them previous to applying them to the soil.

Soot principally consists of charcoal; but its efficiency as a manure is chiefly attributable to its containing ammonia, the amount of which varies in different samples from 1 to 5 per cent. The following is an analysis, by Dr. Voelcker, of soot taken from the farm buildings of the Royal Agricultural College at Cirencester:—

Moisture,	10·620
Organic matter,	44·736
Chloride of ammonium (sal-ammoniac), ...	·933
Sulphate of ammonia,	3·580
Chloride of sodium,	·231
Chloride of potassium,	·503
Oxides of iron and alumina,	15·691
Sulphate of lime,	11·051
Phosphate of lime,	·530
Carbonate of lime,	1·129
Lime in a state of silicate,	2·290
Magnesia in a state of silicate,	·389
Soluble silica (partly combined with lime and magnesia),	4·014
Insoluble silicious matter (chiefly sand), ...	4·159
	<hr/> 99·856

Soot is generally applied as a top-dressing; and it may be scattered at the rate of 15 or 20 bushels or more to the acre; but it is best to apply it as a liquid manure. To grass it is very beneficial; and, deposited together with the seeds of turnips, it quickly forces the young plants into the rough leaf, an object of great importance, inasmuch as when this is the case, the ravages of the fly are in a great measure prevented. This manure has likewise been employed for potatoes with good results, especially when mixed with salt. It is also used for onions, partly as a manure, but more especially for the purpose of preventing the attacks of the onion grub. Mr. Robertson of Kilkenny states, that "On meadows I have used soot with great advantage in substance, and though sown by the hand, one dressing always gave me heavy crops of hay for two successive seasons; but this is a wasteful mode of applying it—a great proportion of its ammonia, one of its most active ingredients, being volatilized and dissipated in the atmosphere. When dissolved in water there is no waste—it is all available for horticultural purposes. I have mostly used it in that state, mixing it up in the proportion of about 6 quarts of soot to a hogshead of water. Asparagus, pease, and a variety of other vegetables, I have manured with it, with as much effect as if I had used solid dung; but to plants in pots, particularly pines, I have found it

admirably well adapted; when watered with it they assume a deep healthy green, and grow strong and luxuriantly."—(*Gardener's Magazine*, vol. ii. p. 19.)

Blood is a powerful and valuable manure, not only on account of its nitrogen, but also on that of the numerous salts which it contains. The organic matter of dry ox-blood, according to Playfair, consists of 54·35 per cent. of carbon; 7·50 of hydrogen, 15·76 of nitrogen, and 22·39 of oxygen. The saline matters in the ashes of blood are exhibited in the following analyses of Enderlin:—

	Ox.	Calf.	Sheep.
Phosphate of soda,.....	16·77	30·18	13·30
Chloride of sodium (common salt),	59·34	52·65	66 57
Chloride of potassium,.....	6·12		
Sulphate of soda,.....	3·85	2·94	5·38
Phosphate of lime and magnesia,	4·19	3·49	13·92
Oxide and phosphate of iron,.....	8·28	9·28	
Sulphate of lime (gypsum) and } loss,..... }	1·45	1·46	0·83
	100·	100·	100·

Blood may be applied to the soil in a liquid state, when dried, or mixed with earth or other substances, so as to form a compost. Of these methods, the latter two are the best; for if blood is applied as a liquid, it must be used immediately, otherwise it will speedily coagulate or clot, and soon enter into decomposition, and thereby ammonia will be formed and lost; but if it is made into a compost, it may be kept for a long time and without loss from decomposition.

Fish form a very powerful manure, rich in nitrogen and phosphoric acid. Large quantities of various kinds of fish are used in Kent, Sussex, Essex, Cornwall, Lincolnshire, Cambridgeshire, and in Scotland. The best mode of using fish in gardens is to make them up into a compost with earth, turf, and other matters; in this way the manure can be more equally distributed, and plants will not then be liable to injury from the roots coming in contact with large quantities of unmixed and highly nutritious manure.

Blubber is an excellent manure. When applied in its crude state, it proves injurious to vegetation; but, formed into a compost with earth, in the proportion of one load of blubber to nine or ten of earth, and turned several times, it has been found to produce very satisfactory results on beans, potatoes, and other root crops.

Graves, or tallow-chandler's refuse, is fre-

quently employed as a manure. It is first bruised, and then dug in. It may be applied at the rate of 8 or 10 cwts. per acre. Another very good plan is to make it up into a compost with earth; but no lime should be employed, as ammonia is thereby driven off.

Woollen Rags.—Considerable quantities of these are employed for manure in Kent, Berkshire, and Oxfordshire. For this purpose, the rags should be chopped up into small pieces, and buried in the soil. They form an excellent manure, which decomposes slowly, and its effects extend over two or three years.

Horns and Hoofs form an excellent manure; but, on account of their use in the arts, they are only procurable in small quantity, and in the shape of shavings or other refuse. In the impure state in which they are used, they contain about 12 or 13 per cent. of nitrogen, and, as they decompose slowly, at least when the fragments are large, they form a good manure for fruit-trees.

Bones, which are so extensively employed in agriculture as a manure for turnips, are also valuable for garden purposes. The composition of bones varies according to the sort of animal to which they belong. It also differs in the same animal at different ages. The bones of the ox, according to Berzelius, consist of—

Cartilage,.....	33·30
Phosphate of lime,	55·35
Fluoride of calcium,	3·00
Carbonate of lime,	3·85
Phosphate of magnesia,	2·05
Soda, with a little common salt,.....	2·45
	100·00

The modes in which bones are applied to the soil are various; they are used broken into fragments of greater or less size, more finely divided in the state of dust; dissolved in sulphuric or muriatic acid; also, mixed with guano or other fertilizers. When applied in the broken state, the effect of this manure is not so speedy, but more lasting, on account of the bones not being so quickly decomposed; but, when the dust is applied, the effect of the application is sooner apparent. When broken into very small pieces, or when applied in the state of dust, a less quantity of bones is necessary to produce an effect, in consequence of their being quickly decomposed. The quantity of half-inch bones, or of bone-dust, which forms an effectual application, is

from 12 to 16 bushels to the acre, according to the nature of the soil, a larger quantity being required on poor soils than on rich ones to produce the same effect. With regard to the sort of bones which it is most advantageous to apply, experience has shown that fresh or unboiled bones possess a more beneficial action than boiled ones, on account of the organic matter not being extracted by boiling, as in the case of the latter; but that, on the contrary, when the soil is already rich in organic matter, the boiled bones form an application of equal efficiency with the unboiled.

For turnips bone manure is invaluable; and it has the great advantage of forcing the plants into the rough leaf, and so enabling them to withstand the attacks of the fly. Its use has likewise been attended with success in the case of carrots, beet, and potatoes. Bones have also been applied with decided advantage to grass land, trees, shrubs, and to vine borders; and bone-dust is used with great success in the flower garden.

Although the beneficial action of bone manure is, to some extent, owing to the animal matter in the bones, yet there is no doubt that it is principally due to the phosphates which they contain. The soils on which bones produce the best effect are dry ones, and more especially such of these as are deficient in phosphate of lime; wet soils are considered as being unsuited for this manure.

Bones are sometimes mixed with earth, ashes, dung, &c., and allowed to ferment, in order to effect their decomposition more speedily than would be the case if they were applied to the soil without such preparation. This plan has worked very satisfactorily, and has produced excellent effects. A better method, however, of rendering bones soluble is to dissolve them in an acid, generally sulphuric. When this acid is poured upon the bones, several chemical changes take place. According to Professor Johnston, the phosphate of lime, which exists in bones in a nearly insoluble state, is converted into the soluble biphosphate, or superphosphate, as it is commonly termed, in consequence of the sulphuric acid seizing on a part of the lime contained in the phosphate of lime. The phosphate of magnesia is likewise converted into a more soluble compound. The carbonate of lime in the bones is converted into the sulphate of lime, or gypsum, carbonic acid being driven off, and

the salts of soda are converted into sulphates, or into a mixture of sulphate and phosphate of soda. The organic matter in the bones is likewise changed into more soluble compounds. Thus, by the action of sulphuric acid, all, or nearly all the constituents of bones are converted into soluble compounds, and are at once fitted to become the food of plants.

The quantity of acid used in dissolving bones is variable; usually, however, the weight of the acid employed is equal to one-half the weight of the bones; but, when the weight of acid is only one-third of that of the bones, the proportion has been found to answer nearly as well. The finer the state of division in which the bones are, and the stronger the acid employed, the more speedy and perfect is their decomposition. Dissolved bones are usually applied to the soil, either mixed with earth or ashes, which is the form generally adopted, or diluted with a large quantity of water as a liquid manure. The quantity of water with which bones dissolved in acid are diluted is about fifty times the weight of the acid employed, a gallon of water weighing 10 lbs. As bones dissolved in acid are immediate in their effects, a much less quantity is requisite, from 4 to 8 bushels of bones, and acid in proportion, being the usual quantity applied to the acre.

Bones are also mixed with guano, soot, rape-dust, dung, or lime, and with excellent results.

Night-soil is a valuable and extremely powerful manure, richer in nitrogen than horse or cow-dung. Its composition, which, however, varies much in different specimens, is exhibited in the following analysis by Berzelius:—

Water,	73.300
Insoluble animal and vegetable remains,...	7.000
Mucus, fatty, and other animal products,...	14.000
Bile, .....	.900
Albumen, .....	.900
Peculiar extractive matter,	2.700
Chloride of sodium, .....	.309
Sulphate of soda, .....	.155
Carbonate of soda, .....	.271
Phosphate of magnesia, .....	.155
Phosphate of lime, .....	.310

100.000

On account of its smell, night-soil should be deodorized before it is employed. This can be effectually done by mixing it with charcoal or sulphate of iron. The use of charcoal for the purpose of deodorizing night-soil appears to be attended with peculiar advan-

tages, for it is not only one of the most powerful deodorizers known, but is itself possessed of great virtue as an auxiliary manure, as will afterwards be shown. The use of sulphate of iron is also attended with advantages, on account of its fixing the ammonia, and deodorizing at the same time; but it is not always advisable to introduce any considerable quantity of the salts of iron into the soil. Gypsum, also, has the property of removing, to some extent, the disagreeable odour, and is likewise of great utility in fixing ammonia.

Quicklime is often used for deodorizing night-soil; but, though it destroys the smell, yet, as it also dispels the greater portion of the ammonia, it should never be employed for this purpose.

This manure is usually applied to the soil mixed with mould, peat, coal-ashes, turf, marl, &c. It is applied in various quantities per acre. Mr. Hewitt Davis finds that 6 tons of night-soil, mixed with peat, is sufficient for an acre; this quantity, however, might in many cases be increased. It is also used in a liquid state; but the former method is superior in point of cleanliness.

Night-soil forms an excellent manure for potatoes, turnips, and, indeed, for most crops, though it is not so much employed as it deserves to be, perhaps on account of its being erroneously supposed to communicate a bad taste to the crop.

Night-soil is procurable in this country at a very small cost—in many cases for little more than the expense of carriage; and, considering its price, and the richness of its composition, it may safely be said to be one of the cheapest, if not the cheapest manure known. Such being the case, it is surprising that it is not more extensively used, and that it is not preserved with greater care, more especially as it can be rendered perfectly inodorous at a very trifling expense.

In Belgium, France, and, indeed, nearly all over the Continent, the night-soil is carefully preserved, and is highly valued as a manure. Its price in Flanders ranges from 10s. to 15s. a ton; but, when prepared into poudrette, it fetches at Montfauçon, near Paris, as much as £2, 10s. per ton.

In China, also, that densely peopled empire, where nothing that can be turned to account is wasted, the value of this manure is fully appreciated. It is there mixed with a sort of marl, and made into cakes which are sold to

the cultivators, and by them mixed with water, and applied to the soil. It is also collected, together with other vegetable and animal refuse, in tubs or pits lined with plaster; these are covered with straw to prevent loss by evaporation. The manure is then diluted with water, and allowed to putrify, after which it is applied to the ground. We in this country might well take a lesson from the Chinese in respect to covering our manure heaps, to prevent the most valuable parts of the manure from being carried off by the action of the sun, wind, and rain. Besides this, the Chinese are too good economists to allow the most soluble and richest parts of the manure to drain away by the sides or bottoms of their pits.

Night-soil is prepared, by drying and mixing with various substances, into what is called poudrette, desicated or disinfected night-soil. The value of this preparation as a fertilizer, of course, depends on the substances with which the night-soil is mixed, and the mode of drying. In the preparation of poudrette, quicklime is frequently added, and to the injurious action of this, by driving off ammonia, we have already adverted.

Guano.—This manure, the value of which is now universally known, is the dung of sea-birds, which has been deposited in the course of hundreds of years, in some places to the thickness of 100 feet. Guano is principally obtained from the small islands on the coast of Peru; the best is got from the Chincha Islands, three in number, whence immense quantities are annually imported into this country.

According to Admiral Moresby's report on the supply of guano, the actual quantity imported into this country from the Chincha Islands, allowing for the difference between registered and real tonnage, must have amounted, in 1851, to upwards of 200,000 tons. Considerable uneasiness has been caused in this country lest the beds of guano become exhausted, and this must sooner or later be the case, by reason of the large quantities which are imported by this and other nations. With reference to the quantity remaining on the Chincha Islands, Admiral Moresby states, that, from the northern or principal island, when he visited it, more than one-third of the guano had been removed, the remainder amounted to 5,500,000 tons; on the centre island, only 1,500,000 tons remained; and

on the southern island, 1,600,000 tons; in all, 8,600,000 tons. Admiral Moresby further adds, that he is of opinion that, at the present average rate of exportation, the islands will be exhausted of the guano that would pay freight, or be saleable in the English market, in eight or nine years.

Guano has also been obtained from other sources, such as Ihaboe, Saldanha Bay, &c.; but, as most of these have been exhausted, and the guano from the remainder is much inferior in quality, we are almost entirely dependent on the deposits on the coast of South America for our supply.

Genuine Peruvian guano is a light brown, or fawn-coloured powder; its chemical composition is exhibited in the following elaborate analyses by Bertels, Oellacher, and Völkel:—

	Bertels.	Oellacher.	Völkel.
Urate of ammonia,.....	3.244	12.20	9.0
Oxalate of ammonia,	13.351	17.73	10.6
Phosphate of ammonia,...	6.250	6.90	6.0
Phosphate of ammonia } and magnesia,.....	4.196	11.63	2.6
Hydrochlorate of ammonia,	6.500	2.25	4.2
Carbonate of ammonia,....	...	0.80	...
Humate of ammonia. ....	...	1.06	...
Oxalate of lime,.....	16.360	1.30	7.0
Phosphate of lime,.....	9.940	20.16	14.3
Carbonate of lime,.....	...	1.65	...
Chloride of sodium,.....	0.100	0.40	...
Sulphate of soda,.....	1.119	4.92	3.8
Phosphate of soda,.....	5.291	...	...
Sulphate of potash,....	4.227	4.00	5.5
Sand,	5.800	1.68	...
Alumina,.....	0.104	...	...
Clay and sand,.....	...	...	4.7
Waxy and resinous matter,	0.600	0.75	...
Water and volatile am- monia, undefined or- ganic matter, and loss, }	22.918	12.57	32.3
	100.000	100.00	100.0

The composition of guano is, however, subject to some variation. The variation and average composition of thirty-two specimens of Peruvian guano, are exhibited in the following table, prepared by Professor Way, for the Royal Agricultural Society of England:—

	Lowest.	Highest.	Average.
Water,.....	8.88	22.68	13.09
Organic matter and salts } of ammonia,.....	37.78	58.82	52.61
Sand,.....	1.17	2.95	1.54
Earthy phosphates,.....	19.46	34.45	24.12
Ammonia yielded by } 100 parts,	15.98	18.94	17.41

The value of guano is now so well known, that it is unnecessary for us to descant on its virtues; suffice it to say, that it has been applied to almost every crop, whether fruit or vegetables, with the greatest success; to flowers, also, its application proves highly beneficial.

Guano should always be mixed with six or eight times its weight of fine earth or loam, or with ashes or charcoal dust, previous to being applied to the soil; for if used in its unmixed state, it is likely, from its causticity, to kill the plants, or, at least, prove injurious to them. In this way it may be used at the rate of 4 or 5 cwt. per acre.

Guano is also employed with great advantage in a liquid form; especial care should, however, be taken not to use too concentrated a solution. The proportion of guano, mixed with water, that may be applied with safety, varies according to the sort of plant, the greater or less vigour of the individual, and the richness of the soil. Many plants grow luxuriantly when watered with a solution strong enough to cause the death of others. Half an ounce of guano to a gallon of water is, however, generally considered to be a safe proportion for all plants; and it will be a safer course to repeat the dose of this solution rather than to increase its strength.

Urine forms an exceedingly powerful manure, containing various principles which, during putrefaction, yield large quantities of ammonia. Urine likewise contains many valuable mineral ingredients of the food of plants.

The composition of urine varies in different kinds of animals, and in individuals of the same species, being affected by the age and food of the individual. Human urine is, however, by far the most valuable.

The following analysis, by Berzelius, exhibits the composition of human urine:—

Water,	933.00
Urea,	30.10
Uric acid,.....	1.00
Lactic acid, lactate of ammonia, and ani- mal matter not separable from them, ... }	17.14
Mucus of the bladder,.....	0.32
Sulphate of potash,.....	3.71
Sulphate of soda,.....	3.16
Phosphate of soda,	2.94
Phosphate of ammonia,	1.65
Chloride of sodium,.....	4.45
Hydrochlorate of ammonia,	1.50
Phosphates of lime and magnesia,	1.00
Silicious earth,	0.03
	1000.00

According to Mr. Brande, 1000 parts of the urine of the cow contains the following substances:—

Water,	968
Urea,	4
Carbonate of potash and ammonia,	4
Hydrochlorate of potash and ammonia,	15
Sulphate of potash,	6
Phosphate of lime,	3
	<hr/> 1000

MM. Fourcroy and Vauquelin found that 1000 parts of the urine of the horse contain:—

Water,	940
Urea,	7
Hippurate of soda,	24
Chloride of potassium,	9
Carbonate of lime,	11
Carbonate of soda,	9
	<hr/> 1000

By the putrefaction of urine, the urea and uric acid which it contains are decomposed, and a large amount of ammonia is formed, and unless means be taken to prevent its escape, much of the most valuable portion of the manure will be lost. Gypsum, sulphuric acid, or sulphate of iron, should therefore be employed for this purpose; and by their use we convert the volatile carbonate of ammonia into the non-volatile sulphate.

Urine, before being applied to plants, should be allowed to putrefy; it should then be largely diluted with water, or mixed with soil or other matters, so as to form a compost; for when used in an unmixed state, it is very injurious to plants.

To fruit-trees, kitchen garden crops, and lawns, the application of urine proves highly beneficial. From the facility with which it can be applied to growing plants, without disturbing their roots, as well as on account of its rich manuring properties, urine is an excellent manure for garden purposes. On account of its offensive smell, it is advisable to deodorize it by some of the numerous means at our command.

Liquid Manure.—Almost every manure may be applied to the soil in a liquid state, consequently, all such might be included under this heading; nevertheless, as when speaking of each manure, the circumstance of its being used in a liquid state has been mentioned, we shall confine ourselves to the common acceptance of the term liquid manure.

Liquid manure is generally considered to imply the drainings of dung-heaps, stables, and cow-houses; and it chiefly consists of urine, together with more or less of the excrements of the animals dissolved by it, or by rain. Collected from such various sources, it is evident that the composition and value of liquid manure must vary considerably according to the kind of animal from which it is derived, the amount of solid matters it contains, the mode of preserving it, and other circumstances.

Liquid manure is very useful in gardening; for, as it contains the fertilizing principles in a liquid state, they are consequently in a condition to be more readily taken up by the spongioles of plants, than if the same principles had been afforded in a solid form. Dung, in many cases, can only be applied to the soil before the crop is planted or sown, as it could not afterwards be dug in without disturbing the roots. But, so far as these are concerned, liquid manure can be applied at any period of the growth of plants. Dung may be too strong at first; and as the advancing crop requires progressively more and more support, the dung may become much exhausted. Liquid manure has, however, the advantage; for it can be applied strong or weak at first, and its application can be followed up in a stronger or weaker degree, as the growth of the plants may require. When the strength of solid manure becomes insufficient, liquid manure affords a ready mode of supplying the defect. The above observations equally apply to all sorts of manure in a liquid state.

Liquid manure is used with excellent effect for pine apples, cucumbers, fruit-trees of all kinds in pots, and, in short, for all plants in pots that require to be stimulated. When it can be had in sufficient quantity, it is beneficially applied to vine and peach borders, and to kitchen garden crops. In using it, however, care should be taken that the soil be not over saturated with it, for in that case it is worse for the spongioles than saturation with pure water. It is a safe plan to water with manure water and pure water alternately.

“The Chinese, who are remarkably skilful in the management of manure, are particularly careful not to waste the smallest portions; and, according to Sir George Staunton, they prefer the dung of birds to that of all others, and next to that night-soil, which they apply in a *liquid* state. ‘Their first care,’

says our author, 'is to construct large cisterns, free from absorption, to contain, beside this manure and soil of every kind, all sorts of vegetable matter, as leaves, or roots, or stems of plants; with all these they mix as much animal water as can be collected, or common water to dilute the whole; and in this state, generally in the act of putrid fermentation, apply it to the ploughed or broken earth.' The Chinese husbandmen, we learn from the same authority, always steep their seed wheat in liquid manure, until it swells and germinates, which, they say, hastens the growth of the plants, and at the same time defends them from the attacks of insects; they also apply liquid manure to the roots of plants and fruit-trees. And how grateful liquid manure is to vines, &c., is well known to most English gardeners. The immense produce of grapes by the great Hampton Court vine, has been supposed to be mainly owing to its roots having penetrated to an adjoining sewer belonging to the palace; and the roots of the nearly equally celebrated vine at Valentines, in Essex, are known to reach an adjoining stagnant canal."—(*Johnston on Fertilizers*.) The ammonia of liquid manure should be fixed by the same agents as previously recommended for urine.

Horse-dung.—The solid excrements of the horse consist of 20·67 per cent. of organic matter, 4·02 per cent. of inorganic matter, and 75·31 per cent. of water. Horse-dung is most beneficially applied to cold, stiff soils; and in order that its mechanical action may be turned to advantage, the dung should not be much decomposed, care being taken, however, that the litter is sufficiently moist for decomposition, without becoming musty in the ground, as it does sometimes in dry weather when it is not previously well soaked.

Of equal weights of horse-dung and cow-dung, the former is the most fertilizing; but taking bulk for bulk of each, it is inferior to cow-dung. Where horse-dung is not applied particularly for the purpose of keeping the ground open, but merely for its manuring properties, it should be previously turned, and during the process it should be well moistened, preferably with the drainings of the farm-yard or other liquid manure; but if such are not at command, water must be used. Fermentation is apt to become excessive in the heap of horse-dung, and then it is injurious, for the ammonia is driven off, and the littery portion in the centre is apt to become

dried up and rendered inert. Means should therefore be adopted to prevent the heat from becoming too great; the heap should be turned, spread out, or watered, before it becomes too hot; and the ammonia, that would otherwise escape, may be absorbed by a covering of soil or turf, or any substance, in short, that is found to prevent the heap from exhaling effluvia. Horse-dung is well adapted for producing immediate action on crops; hence, for such of these as are required to be produced as early as possible, it is well to manure with the droppings shaken from the litter.

Cow-dung.—According to Boussingault, 100 parts of fresh cow-dung contain 8·27 parts of organic matter, 1·13 parts of inorganic matter, and 90·60 parts of water. Cow-dung contains more water than horse-dung, and a smaller proportion of nitrogen. Its fertilizing properties are inferior to those possessed by horse-dung, and from its not readily fermenting, it is colder than that manure. It is slower in its action than horse-dung, but its effects are much more lasting; it is, therefore, better adapted for trees, or any crop that requires the manure to continue for years. For hot dry soils, it is better adapted than horse-dung; but, on the contrary, it is not proper for cold and wet soils, and to such, more especially, it should not be applied in spring, or, at all events, it should not then be employed in its crude wet state. Mixed with horse-dung, or with litter, and the whole slightly fermented, it answers better for damp heavy soils. Some have used large quantities of cow-dung in forming borders for vines and for other fruit-trees, but experience has proved, that after two or three years, the mass of cow-dung becomes inert, and retains too much moisture in winter. For fruit-trees generally, a compost of cow-dung and good turfy loam, is found preferable to cow-dung alone.

There is perhaps no kind of manure that retains moisture so well as cow-dung. It is, therefore, excellent for dry hot soils, and for mulching over the roots of trees; yet in a fresh unfermented state, it will injure the roots of many plants if they come in contact with it where it may happen to be unmixed with soil. By fermentation it is rendered safe for vegetation.

Pig's-dung.—Fresh pig's-dung, consisting of the excrements and urine, contains, according to Professor Solly, 93 parts of dry organic matter, 87 parts of inorganic matter, and

820 parts of water. This manure contains more nitrogen than horse-dung, and is considered equally as powerful as night-soil. In an unmixed state, it is too strong for vegetation; but when mixed with litter and as much earth as will moderate fermentation, it becomes an excellent manure. By throwing in weeds where the pigs can search them over, and which they will not fail to do very assiduously, the portion which they reject is formed into manure of considerable strength. But when weeds enter thus into the composition of manure, it is absolutely necessary that the whole should be thoroughly fermented, otherwise the seeds will germinate, and render the ground manured very foul. If the seeds of a single plant are conveyed in a living state to the quarters along with manure, they will, in many cases, produce thousands of vigorous weeds. When seeds are exposed to moisture, and a degree of heat equal to that which is required for inducing vegetation, they must either grow or rot; they will attempt to vegetate, but, stimulated by heat and moisture, and, at the same time, deprived of air and light, they must soon die. At and near the outside of the heap, seeds may exist cool and free from excitement, and consequently, their vegetative powers will be preserved to produce in due time a crop of weeds, after being transferred, along with the manure, to the ground. It is, therefore, advisable that the manure should be turned after fermentation has gone on so far as to kill all seeds in the interior of the heap. The outside or other cool portions should then be carefully turned inwards, where they will be most subject to the effects of fermentation. By adopting this plan, weeds may be turned to account by partly feeding the animals, and by forming a bulk of manure of that which they refuse to eat. The strength of the manure will, of course, be lessened in proportion to the quantity of weeds and adherent earthy matter introduced; but if no more of these be thrown to the pigs than they can thoroughly moisten, the resulting manure will be strong enough for ordinary garden crops.

Pig's-dung, free from litter or other matters, is employed with very beneficial results in forming with turfy loam a compost for pine apples.

Pigeon's-dung, and the dung of domestic fowls, are excellent manures, approaching guano in strength. They should be mixed with earth before being used, otherwise they

will prove too strong for vegetation. In a liquid form, they have been successfully applied to flowers, producing highly beneficial effects on both hard and soft wooded plants. Great care should, however, be exercised not to make this liquid manure too strong.

Farm-yard Manure.—By this is generally understood the manure produced by horses, cows, or other cattle kept on the farm. It may be that of one kind of these animals, or it may be composed of a mixture of the excrements of several. When the excrements of the several kinds of animals are kept separate, their properties can be ascertained by referring to what has been stated respecting the dung of each, and therefore they need not be here further noticed. But, unless for particular purposes, which may render it desirable to use the dung of one kind of animal in preference, it is in general better that the dung of horses, and that of horned cattle, &c., should be mixed. When this is the case, plants can obtain with greater certainty the various elements which they require for their nourishment. The best farm-yard manure is accordingly formed by mixing together the excrements, both solid and liquid, of the different animals. The liquid portion cannot be better nor more economically employed than by being soaked up by the litter, so that the latter may have, in consequence, moisture enough to allow of its decomposition by a slight fermentation, instead of being dried up and for some crops rendered worse than useless.

With many it has been, and is still a question, whether farm-yard manure should be applied to the soil without the least previous fermentation. But we are convinced that manure is rendered a much readier and better source of food for plants by being judiciously fermented before it is applied to the soil. At the same time we admit, and would strongly urge the necessity of guarding, as much as possible, against the dissipation of its volatile fertilizing principles by violent fermentation. When manure is slightly fermented, it produces a more immediate effect than when it is applied fresh. Vegetable fibre, which constitutes a large proportion of the bulk of farm-yard manure, decomposes but slowly when introduced without previous fermentation into the soil, and, until such time as it does become decomposed, it affords no nourishment to plants. Its presence in that insoluble state may do good in certain soils that require to

be kept open, especially at a particular period of the season. Moderately fermented farm-yard manure, composed of the dung of various kinds of animals, and which likewise contains as much as possible of the urine, is most proper for garden soil that has been duly prepared and reduced to a proper texture.

Composts are mixtures of various earths or manures. Their number may be said to be infinite, and they are of the greatest utility in horticulture. Many different sorts of composts have been already mentioned, and others suited for the growth of particular plants will be noticed when the plants for which they are prepared are spoken of. In general, the best way of economizing all sorts of refuse is to form it into a compost. At the same time, care must be taken not to introduce matters likely to prove antagonistic in their effects. For instance, lime should never be introduced into composts with substances containing ammonia, or producing it in their decomposition.

Many manures, of which only small quantities are necessary, require to be mixed with other substances, in order to insure their even distribution; others, again, are so powerful, that in an unmixed state, instead of proving beneficial to vegetation, they would be actually destructive to it; all such are advantageously formed into composts.

Lime should never be used in composts with animal matters in the decomposition of which large quantities of ammonia are formed. With weeds, and the roots, leaves, and stems of plants, excellent composts may be formed, and the use of lime in this case is not objectionable, more especially as it rapidly destroys vitality. Another excellent mode of economizing all such vegetable refuse is to thoroughly rot it in liquid manure, and this can hardly be applied to a better purpose.

Flesh, hair, feathers, the refuse of sugar-refineries, pond-mud, ditch-scurings, and numerous other kinds of animal and vegetable refuse, the names of which alone it would be tedious to enumerate, may all be advantageously employed as manure. In general it is most economical and convenient to make such substances up into composts with earth, urine, and other matters.

II.—INORGANIC MANURES.

Coal Ashes are useful as manure, and are found to encourage the growth of pease and

beans. When mixed with bones, night-soil, guano, blood, or other substances rich in nitrogen, they form an excellent manure. It is more especially upon stiff clays that coal ashes are found beneficial, and on such they tend to loosen the soil; upon light soils their use does not appear to be attended with much advantage on account of the mechanical action just mentioned. The value of coal ashes is almost entirely due to the sulphate of lime or gypsum which they contain in variable quantities. This manure should never be used in large quantities, as when this is the case, it is apt to prove injurious to plants.

Peat Ashes are very variable in their composition, according to the localities from which they are brought. In some cases these ashes are principally composed of carbonate of lime; whilst in others they contain a considerable amount of the phosphate and sulphate of lime, and are of considerable value, as in the case of Dutch ashes, which are much esteemed in Holland as a manure for turnips and clover.

Peat ashes are usually applied as a top-dressing, at the rate of 20 or 30 bushels to the acre. The value of peat ashes as a manure is exceedingly variable.

Wood Ashes form a valuable manure, always containing potash and soda, besides other inorganic elements of the food of plants, as will be seen on referring to the table of the composition of ashes, at pp. 74–76. Wood ashes are exceedingly well adapted for mixing with guano or dung. They are also an excellent manure when applied by themselves. Of course they will not supply the want of organic manure.

The roots of plants, weeds, &c., are frequently burned, and their ashes applied to the soil; but as all the organic matter is lost by this means, the practice is not to be recommended. It is far more economical to form them into a compost with earth and quicklime, or other substances, to destroy their vitality; after they have been thoroughly decomposed and brought to the state of vegetable mould, they are excellent for horticultural purposes.

Charcoal forms a valuable auxiliary to manures, and, indeed, when applied to the soil without the admixture of manuring substances, it has great fertilizing properties. Its action, in either case, is almost entirely due to its well-known property of absorbing ammonia, carbonic acid, and other gases, and again giv-

ing up these substances for the nourishment of plants; for, as far as the carbon of the charcoal is concerned, that yields no food to plants. There is no doubt, however, that the mineral matters contained in charcoal, as usually prepared, contribute in some measure to its fertilizing effects. It also renders the soil, to which it is applied in any considerable quantity, lighter and more friable. Another circumstance worthy of remark is, that charcoal, by darkening the colour of the soil, increases the power of the latter to absorb heat—a point of no small importance. Charcoal forms an excellent mixture with guano and other artificial manures, in order to secure their more even distribution. When so employed, it not only answers this purpose, but, from its power of absorption, prevents the escape of the ammonia when more of this is liberated than can at once be absorbed by the soil, or by the roots of plants. By reason of this property, it forms an excellent covering for manure heaps, and prevents all bad smell. When applied by itself, it has been found to produce very beneficial effects on turnips and carrots. Mr. Cut-hill also speaks highly of the effects of Irish peat charcoal, when mixed with the soil, on cucumbers, melons, strawberries, and potatoes.

Ashes of Burned Clay.—Burned clay is extensively used in the heavy lands of Essex, Suffolk, and other parts of England, and the practice is attended with great success. The beneficial action of burned clay is chiefly due to its altering the texture of the soil, rendering this less compact, and consequently more permeable to air, water, and the roots of plants, and to the burned clay containing a much greater proportion of soluble alkalies, more especially of potash and soda, than the unburned clay, a considerable portion of the alkaline substances contained in the latter being rendered soluble in the process of burning. Burned clay, by improving the texture of the soil, and by supplying a greater amount of alkalies to plants, must prove beneficial to all crops; but it is more especially on turnips, carrots, and potatoes, or on plants requiring a large amount of potash, that the beneficial effects of this manure are visible.

The state to which the clay is reduced by burning is of great importance; for if exposed to too great a heat, it will become of the nature of brick, and its alkaline ingredients will be less soluble than if burning had not been resorted to. The clay should only be slightly

burned, and so that it may readily crumble down. Mr. Meehi thus describes the mode he adopts in burning clay:—"The mode of raising and burning is this:—A strip of land is broken up in very dry weather with Ransome's Y. L. plough, drawn by three strong horses abreast a Scotch equilibrium whippletree. So great is the resistance, that it requires two men to hold the handles of the plough to counteract the leverage of the horses. The earth is thus broken, or I may say torn up in immense rough masses or clods, as much as a man can carry, which are admirably adapted to form walls and supports for the mass of fire. By this means heaps of nearly 200 solid yards may be readily burned. The earth being ploughed up, the fires are formed on the spot, the workmen placing a certain quantity of dried stumps of wood of sufficient solidity to maintain a body of heat, and inclosing the mass with large clods. These are carried by hand: subsequently, as they get more distant from the fire, a barrow is used, and beyond that a one-horse cart.

"It is important to have the sides of the heap as upright as possible—not conical, because the heat always makes for the highest place. An important point in burning is to supply the fire sufficiently fast to prevent its burning through, and yet avoid overlaying it, which might exclude all air and put it out. Practice will indicate the medium. When the fire shows a tendency to break through, the outside of the burning mass is raked down and more earth added.

"If the ground is very dry, and no rain falls, the men are obliged to feed the fire almost continually night and day; but when there is moisture, it may be left for five or six hours, but seldom longer. Something depends on the current of air. A strong wind would blow the fire from one side and out at the other. This is guarded against by placing hurdles interlaced with straw as a guard to windward. The size of a heap is limited by the height to which a man can throw up the soil, and of course the diameter must be proportioned to the height to prevent its slipping down. It is generally lighted so as to burn out by Saturday, and not require Sunday attendance."

Gas Waste.—The ammoniacal liquor obtained in making gas is employed as a manure, and with good effects. It consists of a solution of the carbonate, hydrosulphate of ammonia, and

other salts of the same base. All its value is due to the ammonia which it contains; the amount of this is subject to considerable variation, but rarely exceeds 2 per cent. On account of its caustic nature, gas water should always be applied with caution, and it should be diluted with five or six times its bulk of water, otherwise it is certain to burn up whatever crops it is applied to. To prevent the escape of ammonia, sulphuric acid, or some of the other substances previously recommended for that purpose, should be employed. According to Solly, the average quantity of strong sulphuric acid requisite for this purpose is from 20 to 25 lbs. for every 100 gallons of gas liquor; a little excess of acid, he observes, hardly ever does any harm, as it immediately becomes neutralized by lime, &c., in the soil.

Gas water is chiefly applied to grass, and may be used at the rate of from 100 to 200 gallons per acre; but for the reason previously given, it must be diluted with water. This, of course, involves a considerable amount of labour; and it may be observed, that on retentive soils, this excessive drenching with water cannot but prove injurious. It may likewise be successfully applied to other crops.

Gas lime is the lime which has been employed in purifying the gas, and it always contains a large quantity of the sulphuret of lime, the action of which on vegetation is unquestionably injurious. For this reason, the use of gas lime in a fresh state as a manure is not to be recommended. After long exposure to the action of the air and water, the hydrosulphuret of lime is converted into sulphate of lime or gypsum, and its injurious action ceases. Gas lime is then merely a mixture of gypsum and lime, which may or may not be free of injurious compounds, and a manure which it is safer to dispense with than to use, at least in the garden.

Gas tar consists almost entirely of carbon and hydrogen, and is of little or no value as a manure, though it has been occasionally used as such.

Lime has long been employed as a manure, and its application to the soil has been attended with great success, especially when preceded by drainage.

Lime is an oxide of the metal calcium. It does not occur in nature in a free state, but united with carbonic acid, forming carbonate of lime, it is found in abundance. There are

many varieties of carbonate of lime, but the most common are limestone and chalk. Pure carbonate of lime consists of 56.3 per cent. of lime, and 43.7 per cent. of carbonic acid. On being exposed to a strong red heat, carbonate of lime loses its carbonic acid, and protoxide of calcium, or *quicklime* is produced. This substance has a powerful affinity for water, absorbing it rapidly when brought in contact with it, and more gradually when exposed to the atmosphere; in both cases, a compound of the hydrate of lime, consisting of 28.5 parts or 1 equivalent of lime, and 9 parts or 1 equivalent of water, is produced.

The process by which the hydrate is formed is called *slaking*, and it is always attended with a great increase of temperature. The hydrate itself is termed *slaked lime*. After long exposure to the air, the hydrate of lime parts with its water, absorbs carbonic acid, and again becomes carbonate of lime.

Quicklime is extremely caustic, decomposing all animal and vegetable matters with which it comes in contact, and causing the formation of carbonic acid, ammonia, and other compounds; hence it is of great utility in fertilizing peats, and all soils abounding in roots and inert vegetable matter, by decomposing the vegetable fibre, and reducing it to a more soluble state.

Respecting the chemical action of lime in the soil, much uncertainty prevails. There is no doubt that lime, by decomposing vegetable matter, contributes to the food of plants by supplying them with carbonic acid, ammonia, &c. Liebig ascribes the beneficial action of lime chiefly to its affording a supply of potash and soda, by decomposing minerals which contain these substances. Lime is itself a necessary element of the food of plants, and its application may in some cases prove beneficial by furnishing plants with an indispensable element of their food; but it would only be in soils extremely deficient in lime, and of such there are few, that this would be the case. We may therefore conclude, that lime acts more by bringing other substances into a proper condition for being absorbed by the roots of plants, than by affording nourishment of itself. Some soils, especially such as are peaty, become what is called *acid* or *sour*, owing to the presence of vegetable acids; on such soils lime acts as a corrective, by uniting with and neutralizing the vegetable acids.

Lime in its hot or caustic state is applied

with great advantage to soils containing an excess of inert vegetable matter, such as peaty soils and recently broken up grass land. The roots, fibres, &c., in these cases would long remain in the soil in an undecomposed state, and one in which they could yield no nourishment to plants; but lime, by decomposing and rendering soluble this vegetable matter, reduces it to a state in which it can be taken up by the roots of plants, and assimilated.

The addition of lime to clay soils is not only followed by the usual chemical effects produced by the application of lime, but the texture of the soil is also improved. The effects of lime on clays, however, greatly depend on the amount of organic matter which these contain. If the soil is deficient in this respect, lime will chiefly prove advantageous by liberating the alkalies potash and soda.

The quantity of lime that should be applied to an acre of ground varies from 30 to 200 bushels. Where the soil contains much vegetable matter, as in the case of grass land which has been recently broken up, the larger quantity may be advantageously employed for a first liming. Clay soils generally require more than light loams or sands; and whenever there is only a small amount of vegetable matter in the soil, lime should be used only in small quantities, otherwise exhaustion will be the result.

In all cases, it should be remembered, that lime will not supply the place of organic manure, and that it merely renders this available for the nourishment of plants. Where the ground has been long manured with farm-yard manure, the use of small doses of lime proves very advantageous in hastening the decomposition of the vegetable matter.

In applying lime to the soil, it should be used as a top-dressing, or forked in so as to mix it well with the soil. From the tendency which lime has of sinking deeper and deeper into the earth, it frequently accumulates in the subsoil. If the nature of the latter will permit, the lime may be recovered by trenching it up, and this, in most cases, is preferable to liming afresh.

Lime is very advantageously employed in forming composts with ditch-scurings, earth, weeds, &c., as it hastens the decomposition of the vegetable matter, liberates alkalies, destroys the vitality of seeds, roots, &c., and kills vermin, besides itself contributing to the fertilizing effects of the mixture.

Lime made from magnesian limestone, and containing caustic magnesia, has been found to act injuriously on many soils. This action has been investigated by Sir Humphrey Davy, who makes the following interesting remarks on the subject:—

“Magnesia has a much weaker attraction for carbonic acid than lime, and will remain in the state of caustic or calcined magnesia for many months, though exposed to the air. And as long as any caustic lime remains, the magnesia cannot be combined with carbonic acid, for lime instantly attracts carbonic acid from magnesia.

“When a magnesian limestone is burned, the magnesia is deprived of carbonic acid much sooner than the lime; and if there is not much vegetable or animal matter in the soil to supply, by its decomposition, carbonic acid, the magnesia will remain for a long while in the caustic state; and in this state acts as a poison to certain vegetables. And that more magnesian lime may be used upon rich soils, seems to be owing to the circumstance, that the decomposition of the manure in them supplies carbonic acid. And magnesia in its mild state, that is, fully combined with carbonic acid, seems to be always a useful constituent of soils. I have thrown carbonate of magnesia upon grass, and upon growing wheat and barley, so as to render the surface white; but the vegetation was not injured in the slightest degree. And one of the most fertile parts of Cornwall, the Lizard, is a district in which the soil contains mild magnesian earth. That the theory which I have ventured to give of the operation of magnesian lime is not unfounded, is shown by an experiment which I made expressly for the purpose of determining the true nature of the operation of this substance. I took four portions of the same soil; with one I mixed one-twentieth of its weight of caustic magnesia, with another I mixed the same quantity of magnesia and a proportion of fat decomposing peat, equal to one-fourth of the weight of the soil. One portion of soil remained in its natural state; and another was mixed with peat without magnesia. The mixtures were made in December, 1806; and in April, 1807, barley was sown in all of them. It grew very well in the pure soil; but better in the soil containing the magnesia and peat; and nearly as well in the soil containing peat alone; but in the soil containing the magnesia alone it rose very feeble, and looked yellow and sickly.

"I repeated this experiment in the summer of 1810, with similar results; and I found that the magnesia in the soil mixed with peat became strongly effervescent; whilst the portion in the unmixed soil gave carbonic acid in much smaller quantities. In the one case the magnesia had assisted in the formation of a manure, and had become mild; in the other case it had acted as a poison.

"It is obvious, from what has been said, that lime from the magnesian limestone may be applied in large quantities to peats; and that where lands have been injured by the application of too large a quantity of magnesian lime, peat will be a proper and efficient remedy.

"I mentioned that magnesian limestones effervesced little when plunged into an acid. A simple test of magnesia in a limestone is this circumstance, and its rendering diluted nitric acid or aquafortis milky."

Chalk is a variety of carbonate of lime; besides this substance, it usually contains 4 or 5 per cent. of other matters, which generally consist of clay, sand, potash, soda, oxides of iron, phosphoric and sulphuric acids.

Chalk acts both mechanically and chemically when applied to the soil. The principal mechanical effects produced by chalk are the alteration which it produces in the texture of the soil, rendering soils which are light and incapable of retaining a sufficient quantity of moisture more compact and retentive; at the same time, by this change in the texture of the soil, rain is prevented from washing away the soluble substances necessary for the support of plants.

All plants contain lime, and it may be concluded that chalk, which is sparingly soluble in water containing carbonic acid, acts partly by supplying this necessary element. It has been stated that chalk generally contains other substances besides carbonate of lime. Of these, phosphoric acid, potash, soda, and sulphur, are all necessary to vegetation; and in practice it has been found that the richer chalk is in these, the more beneficial are its effects.

The soils to which chalk may be applied with the greatest advantage are such as are light and sandy, and those containing too small a proportion of lime.

Gypsum, or sulphate of lime, is a combination of one equivalent of sulphuric acid with one equivalent of lime. In its natural state, it always contains a considerable proportion

of water, which may be expelled by exposing it to a temperature of 270° ; it then becomes plaster of Paris. One hundred parts of gypsum consist of 32.5 parts of lime, 46.5 of sulphuric acid, and 21 of water. Gypsum is sparingly soluble in water, requiring for solution 500 times its weight of cold, or 450 of boiling water.

Many different opinions are entertained respecting the action of gypsum as a manure. Some chemists consider that it acts by supplying direct nourishment to plants, affording them sulphate of lime, which is found in their ashes. This was the opinion of Sir Humphrey Davy. Liebig, again, ascribes its action partly to its supplying plants with sulphate of lime, and also sulphur; and partly to its presenting them with ammonia, by converting the carbonate of ammonia into the sulphate, and thus preventing the escape of the former volatile salt from the soil. On the other hand, this view of the question is contested by M. Bous-singault, who shows, that under ordinary conditions of moisture in the soil, the carbonate of ammonia is not converted into the sulphate by gypsum; and he supposes that gypsum merely acts as a source of lime. He states that he is led to this conclusion by the results obtained from the analyses of the ashes of plants, and by gypsum only acting in such soils as are deficient in carbonate of lime. Whatever be the true theory of the action of gypsum, there appears to be no doubt that it becomes, at least to some extent, a portion of their food; but whether this is sufficient to account for all its fertilizing effects is very doubtful, and it is not a little remarkable that some plants containing a comparatively small proportion of sulphate of lime, receive more benefit from its application than others which contain it in greater amount.

Gypsum has been applied with considerable success to grass, and more especially to lucerne, sainfoin, and clover. Good results are also stated to have followed its application in the case of turnips and potatoes. It is used as a top-dressing, and at the rate of 2 or 3 cwts. per acre, sometimes less, sometimes more. It is found to produce the best effects when sown in wet weather; and in America they are very particular to use it after a shower of rain.

The soils to which it is considered best adapted are light or sandy ones; though it has also been successfully used on heavy soils.

The reason why gypsum produces no benefit in many soils, is doubtless owing to its already existing in them in sufficient quantity.

Gypsum is but little employed in this country; but in the United States its application has been attended with great success.

The power of fixing ammonia, which gypsum possesses, has already been mentioned; but it is necessary to observe, that it will only prove effectual for this purpose when water is present in sufficient quantity. Accordingly, it is most advantageously used in the case of liquid manures; but for fixing the ammonia of solid manures, it does not answer nearly so well.

Phosphate of Lime is found native in Spain. It likewise exists in large quantities in coprolites, and in bones, the fertilizing effects of which are principally due to the presence of this substance. All organic manures, and some kinds of chalk and marl, contain phosphate of lime, though in less quantities than in the first-mentioned cases.

Phosphate of lime is found in nearly all plants; and on account of its supplying phosphoric acid, constitutes a valuable addition to all soils.

Coprolites, or the fossil excrements of animals, are found in most geological strata; but more especially in the green-sand, lias, and Suffolk crag.

They occur in rounded nodules, generally of small size, which have a stony appearance and brown colour. They consist principally of phosphate of lime, phosphate of magnesia, and carbonate of lime. Some coprolites have been found to contain as much as 70 per cent. of phosphate of lime; but in general the proportion of this substance rarely exceeds 55 per cent. On account of the phosphates of lime and magnesia which they contain, coprolites are a valuable manure. They are used either in a ground state, or submitted to the action of sulphuric acid, when they are converted into superphosphate of lime and gypsum.

Marl.—This term is employed to designate various earthy substances, principally consisting of clay or sand, but all containing more or less calcareous matter.

The use of marl as a manure dates from a very early period. It is mentioned by Pliny as being found in Britain, and employed for improving the soil; and there is no doubt that marl was commonly used for this purpose at a much earlier period. Marls may be divided

into six principal varieties, namely—1. clay-marl; 2. sandy-marl; 3. chalk-marl; 4. slaty or stony-marl; 5. shell-marl; 6. peaty-marl.

1. Clay-marls are applied with great advantage to all loose and sandy soils, the texture of which they greatly improve by communicating to them the requisite degree of tenacity. Peaty soils are likewise benefited by the application of clay-marl, the lime in which neutralizes the vegetable acids in the peat. The beneficial action of clay-marls is not solely attributable to the alteration which they effect in the texture of the soil to which they are applied, for it is partly due to the carbonate of lime which they contain, and likewise to their frequently affording a supply of phosphoric acid, potash, and soda, which are often found in small quantities in clay-marls.

2. Sandy-marls consist principally of sand, of which they often contain as much as 70 or 80 per cent. The amount of lime which is present in these marls is also variable. In some it occurs to the extent of 30 per cent.; in others, it is less than 10 per cent.

Sandy-marls greatly improve stiff and retentive clays, the friability of which they greatly increase.

3. Chalk-marls consist principally of carbonate of lime, and may be applied with advantage to all soils deficient in calcareous matter, and wherever the use of chalk is attended with good effects. Some chalk-marls are rich in phosphate of lime. When this is the case, they are applied with advantage to nearly all soils, even to those which already contain a considerable amount of carbonate of lime.

4. Slaty or stony-marls. Of these, some have a gravelly appearance; others, that of indurated clay; some contain a considerable amount of carbonate of lime, whilst others consist principally of sand, with but a small quantity of lime. These marls, when exposed to the action of air, water, and frost, soon become powdery, and readily mix with the soil. When phosphate of lime is present in marls of this sort, their value is greatly increased; but some of them contain a considerable amount of oxide of iron; and when this is the case, they should be employed with caution, otherwise bad results may arise from their use.

5. Shell-marls consist of the remains of infusorial animals, and of the shells of shell-fish, mixed with sand, clay, and some organic matter, the whole in a finely divided state. These

marls are rich in carbonate of lime; and the organic matter and phosphate of lime which they contain add materially to their value. Shell-marls may be beneficially applied to all soils deficient in calcareous matter; likewise to sour peaty soils.

6. *Peaty-marls.* Marls are occasionally found which contain a considerable amount of peat; these form a valuable addition to soils deficient in organic matter. As they are very wet when first dug up, and retain moisture for a long time, they ought not to be applied in a fresh state. On this account they should either be made up into a compost, or burned; but if the latter method be adopted, the organic matter will be lost, and the marl will merely be valuable for the lime and other inorganic substances which it may contain.

The quantity of marl which should be applied to the acre, is entirely dependent on the nature of the soil, and the composition of the marl itself.

Limestone Gravel occurs chiefly in Ireland; it is of the same appearance as common gravel, only of a blue colour, and effervesces briskly with hydrochloric acid. This gravel is sometimes very fine, approaching to marl in its nature. It is used with great advantage on bogs and strong clays; it produces on the latter, all the effects of a dressing of marl, greatly increasing their friability.

Calcareous Sands are much employed in some parts of the country, not only for improving the texture of the soil, but also for the sake of the carbonate of lime, which some of them contain to the extent of 60 per cent. and more.

In Devonshire and Cornwall, immense quantities of shell-sand—a calcareous sand, consisting chiefly of sand and the remains of shells, together with a little organic matter—are carried many miles inland, for the purpose of applying it to the land. Deposits of shell-sand are likewise found on the west coast of Scotland, and in the Hebrides; also, on the north, south, and south-west coasts of Ireland.

Coral-sand, closely resembling shell-sand in its composition and effects, is found on the south coast of Ireland.

Calcareous sands are of great benefit to all soils deficient in lime; they are also advantageously employed in improving heavy retentive soils, to which they not only supply calcareous matter, but also improve their texture. Calcareous sands are likewise applied

with excellent results to peaty soils, the vegetable acid of which they neutralize.

Some of these sands contain a considerable amount of phosphoric acid and organic matter; when such is the case, they are most valuable fertilizers.

Soapers' Ashes consist principally of carbonate, sulphuret, and sulphite of lime, a minute quantity of potash, and other saline matters; together with sand, cinders, and some other impurities.

By exposure to the action of the air, sulphuret and sulphite of lime are converted into sulphate of lime; and the whole is then merely a mixture of sulphate and carbonate of lime, with a trifling amount of potash and soda. Soapers' ashes are of little value as a manure. They certainly may be used as a substitute for carbonate of lime and gypsum; but in all cases, previous to being applied, they should be exposed to the action of the weather for a long time, in order to insure the perfect oxidation of the sulphur compounds, otherwise bad effects are likely to result from their use.

Magnesia is found in the ashes of plants. In its caustic state, it appears to be injurious to vegetation; but one of its salts—sulphate of magnesia, or Epsom salt, a compound of sulphuric acid with magnesia—has been used with some success as a manure for potatoes and turnips. The fertilizing action of sulphate of magnesia is no doubt due, in a great measure, to its supplying sulphuric acid, as well as magnesia, to plants. As this salt is very soluble in water, it should never be applied in large quantities, otherwise it is likely to prove injurious to plants, in consequence of the roots of these absorbing it in greater amount than is necessary for the nourishment of the plant.

In some experiments made by Professor Solly, in the garden of the Horticultural Society at Chiswick, sulphate of magnesia was applied as a manure for potatoes, at the rate of 3 cwts. per acre, and with satisfactory results; but its effects were inferior to those produced by many other manures. On account of its high price and its small effects, sulphate of magnesia is never likely to be much employed as a fertilizer.

Phosphate of magnesia is found in bones, and other organic manures. The use of these is, doubtless, the cheapest and most advantageous way of supplying magnesia, when we

take into consideration the other important and highly fertilizing principles which such manure contains.

Ammonia, from its being the great source from which plants derive their nitrogen, is one of the most important components of manures. To its presence, or formation, guano, the excrements of animals, flesh, blood, &c., owe much of their value as fertilizers. All manures containing ready-formed ammonia exercise a peculiar stimulating action on vegetation, producing a luxuriant and rich dark green foliage, together with a great increase in the crop.

Ammonia is supplied to plants by the decomposition of organic matter in the soil, by which, when thus generated, it is retained. It is likewise continually formed in the air by the decay of organized bodies, of both animal and vegetable origin. The ammonia existing in the atmosphere, in the state of a carbonate or nitrate, which salts are very soluble in water, is soon carried down to the earth by rain and snow, the water of which always contains ammonia. In this way, a considerable amount of ammonia is supplied to plants. But the soil, subjected to a continued course of cropping, soon becomes exhausted of the organic matter capable of forming ammonia; and plants would only have to depend on the ammonia brought down by rain. Now, though this quantity of ammonia would be sufficient to supply the necessary amount of nitrogen to plants growing in a state of nature, yet it would prove totally inadequate to meet the greatly increased demand induced by cultivation, and to compensate for the large quantity of nitrogen carried away in the crop. To maintain fertility ammonia must, therefore, be artificially restored to the soil.

The beneficial effects of the practice of allowing land to lie for a considerable time before it was again cropped, were, without doubt, partly due to the gradual restoration of ammonia to the soil by means of rain, and absorption from the air by the soil.

For the reasons before-mentioned, ammonia must be supplied to the soil; this is effected either by the use of organic manures, rich in nitrogen, or ready-formed ammonia; or by employing some of the salts of ammonia. The salts of ammonia which are used for this purpose, are the sulphate, muriate, or sal-ammoniac, as it is commonly called, and the

phosphate. All these are extremely powerful in their action, and immediate in their effects, requiring at the same time to be employed with great caution.

Any of these salts may be applied at the rate of 2 or 3 cwt. per acre with perfect safety. They should be used as a top-dressing, and in moist weather, or the ground may be copiously watered after their application. They may likewise be very advantageously employed dissolved in water, as a liquid manure; and in this way they are peculiarly beneficial to growing plants, whether in pots or in the open ground; especial care should, however, be taken not to use a solution of too great strength.

Potash is an important part of the food of plants, and is found in large quantities in their ashes; yet, in most soils, it is only found in small quantities in a soluble state; it is, consequently, a valuable constituent of manures. Its salts are found in small quantities in the excrements of various animals, and in most organic manures.

Much of the value of wood ashes, as a manure, is due to the carbonate and other salts of potash which they contain; and this is confirmed in practice by the beneficial effects which wood ashes produce on beans, pease, potatoes and turnips, which are all plants that contain much potash. The fertilizing effects produced by the application of burned clay, are partly due to the greater solubility of the potash which it contains, and the beneficial action of lime is likewise partly attributable to its liberating potash and soda in the soil.

The salts of potash which occur in manures, are the carbonate, sulphate, nitrate, silicate, and phosphate of potash, and the chloride of potassium, or muriate of potash.

The only salts of potash that have been used to any extent, as a direct application to the soil, are the nitrate and silicate; the others occurring in dung, urine, wood ashes, and other manures, are all used indirectly.

Nitrate of Potash, commonly called *nitre* or *saltpetre*, is a compound of one equivalent of potash, with one of nitric acid. Its composition per cent. is—potash 46.54, and nitric acid 53.46. It is prepared artificially, in some parts of the Continent, from a mixture of common mould and calcareous earth, with animal and vegetable remains containing nitrogen. When a heap of these matters is preserved moist in

a shaded situation, and moderately exposed to the air, nitric acid is slowly generated; and this combining with the potash and other bases in the mixture, nitrate of potash and other nitrates are formed. Many composts, doubtless, contain nitrate of potash formed in this manner, which we use as a manure, though unaware of its presence.

"A great many rich and fertile soils are found to contain a small quantity of nitrate of potash, soda, or lime, which appears to produce nearly the same effect as the salts of ammonia, rendering vegetation vigorous and dark coloured. The way in which these salts are formed will be easily understood when we remember, that whenever substances containing nitrogen decay in the neighbourhood of lime or alkaline salts, a portion of nitric acid is formed. Under these circumstances, the ammonia which would otherwise be produced, is oxidized, and nitric acid and water are formed in place of ammonia; the acid combines with the alkali, and nitrate of potash or soda results. These salts are frequently found in mixtures of decomposing organic manures; they are formed in the same way in the soil itself.

"The effects produced on different plants by alkaline nitrates are very various, some being far more beneficial than others. Some plants, such as the sunflower, tobacco, lettuce, and many others, always contain more or less of these salts. Others do not contain them; but when supplied with nitrates, are subsequently found to contain the base without the acid. The soda, potash, or lime, is combined with some organic acid, whilst the nitric acid has disappeared. It is probable that in these cases the nitrogen of the acid is assimilated by the plant, or that it assists in the formation of gluten and albumen.

"Nitrates can have but very little value as manures on the soils which naturally contain salts of nitric acid, or which, in consequence of the substances they contain, are constantly forming nitrates. On soils neither containing nitrates nor other alkaline salts, they appear to produce very beneficial results. It has been found that wheat manured with alkaline nitrates contains more gluten and albumen than that grown on land not so manured.

"These remarks apply equally to nitrate of soda and nitrate of potash; at least similar effects are produced by the two salts, as far as regards the increased formation of gluten and albumen."—(Solly's *Rural Chemistry*.)

Mr. Johnston, in his book *On Fertilizers*, states, that his experiments with saltpetre were principally confined to grass both on a gravelly and chalky soil, in which the growth of the crop was always materially increased. He also remarked, that when spread at the rate of 2 cwts. per acre on horse-radish beds, the growth of this root was considerably improved. Mr. Johnston further states that he was first led to try the effect of saltpetre on the horse-radish from having experienced considerable difficulty in making it grow luxuriantly, and from observing that, like the nettle, sunflower, &c., it always flourished best in rich patches near to old walls, stable-yards, &c., in which soil saltpetre is invariably to be found.

Silicate of Potash and Soda.—If finely powdered silica be mixed with the carbonate of potash or soda, and exposed to a strong heat, they melt and form glass. Though common glass is insoluble in water, yet if the proportion of alkali be increased, a perfectly soluble compound may be produced, which is a silicate of potash or soda, according to the alkali employed. On account of the silica in the silicates of potash and soda existing in a soluble state, it was supposed that they would prove particularly beneficial to corn and grass crops by supplying them with silica. The results of various experiments, made by Mr. Lawes and others, do not justify these expectations. In some cases an increase of produce has taken place; but it is probable that this was more owing to the alkali contained in the silicates than to the silica itself.

Soda.—This is usually found in the ashes of plants in less quantities than potash, and in most soils and manures the salts of soda are found in sufficient amount to supply the wants of vegetation. Hence the salts of soda are of much less value as manures than the salts of potash.

In places distant from the sea, the amount of soda in the soil is in some cases so far diminished as to be insufficient to satisfy the demands of plants; the application of soda in some form accordingly becomes necessary.

Soda is supplied to the soil by animal and vegetable manures, kelp, and wood ashes, and by means of various of its salts. The principal salts used for this purpose are the sulphate, nitrate, and silicate of soda, and chloride of sodium or common salt.

Sulphate of Soda, or Glauber's Salt, as it is

commonly called, has been successfully used in many cases, at the rate of 2 cwts. per acre, as a manure; whilst in others, its effects have proved unsatisfactory, probably because the soil already contained a sufficient amount of soda. Sulphate of soda may prove beneficial by supplying plants with sulphur as well as soda.

Nitrate of Soda, commonly called *cubic petre*, or *cubic nitre*, is found native in large quantities in South America, and is used to a considerable extent as a manure. The similarity in the effects of this and other nitrates, to those produced by ammonia, has been already alluded to, as well as the action of nitrates in general.

Nitrate of soda has been successfully applied at the rate of 1 cwt. per acre as a top-dressing to grass. In some experiments made by Professor Solly in the garden of the Horticultural Society at Chiswick, nitrate of soda was applied as a top-dressing at the rate of 3 cwts. per acre to potatoes, and the effects were only inferior to those produced by muriate of ammonia. The respective results are exhibited in the following table:—

MANURE.	Whole produce, Tubers.			Large Tubers.			Whole Haulm.	
	tons.	cwts.	lbs.	tons.	cwts.	lbs.	cwts.	lbs.
None,	11	7	109	10	4	105	6	39
Phosphate of ammonia,	13	2	6	11	16	78	9	0
Sulphate of ammonia,	14	9	105	13	6	101	8	27
Common salt,	15	2	72	13	18	2	11	35
Nitrate of soda,	15	9	89	14	1	22	10	36
Muriate of ammonia ..	17	1	75	16	15	7	15	77

The plants in the beds manured with nitrate of soda and ammoniacal salts, were alike characterized throughout by their more vigorous growth and rich dark green foliage.

In another experiment on pease, in which ten other manures were employed, nitrate of soda produced the least effect, muriate of ammonia the greatest. The produce of ripe seed and straw per acre was as follows:—

MANURE.	Seed.			Straw.	
	tons.	cwts.	lbs.	cwts.	lbs.
Nitrate of Soda,	0	16	54	13	57
No manure,	1	1	104	16	54
Muriate of ammonia,	1	2	61	17	98

Nitrate of soda has been found particularly beneficial to grain crops; in some cases the produce has been nearly doubled after its use; in others, the results have been less successful.

It is probable that the beneficial effects produced by nitrate of soda are more to be attributed to the nitric acid than the soda which it affords.

Common Salt.—Chloride of sodium, or muriate of soda, as it is sometimes, though incorrectly, called, is a compound of one equivalent of chlorine united with one of sodium. When pure, 100 parts of salt contain 39.66 parts of sodium, and 60.34 parts of chlorine. Commercial salt, however, generally contains a considerable amount of impurities, the principal of which are sulphate of lime, the chlorides of calcium and magnesium, and sulphate of magnesium.

Common salt has been long applied as a manure; and in moderate quantities, and on certain soils and situations its use has been attended with very beneficial effects. It is well known that salt, when used in large quantities, proves destructive to vegetation; accordingly, strong solutions of salt are frequently employed for the purpose of destroying weeds. But it is also known that the application of a quantity of salt, which proves beneficial to one kind of plant, will be injurious to another. After the inundation of Friesland by the sea in 1825, the oak, mulberry, pear, peach, and other deep-rooting trees, were not injured, neither were asparagus, onions, and celery; but apricots, apples, cherries, poplars, and willows, merely pushed out a few leaves, and soon afterwards perished. A series of experiments was made by Dr. Voelcker as to the amount of salt which various plants will bear without injury; the summary of the results of these experiments we quote from an article by that gentleman in Mortou's *Cyclopaedia of Agriculture*:—

"1. Salt solutions, containing 3 grains of salt per imperial pint, or 6 grains, 12 grains, and even 24 grains of salt per pint, produced no injurious effects on cabbages, field beans, onions, lentils, chickweed (*Stellaria media*), groundsel (*Senecio vulgaris*), thistle (*Cirsium pratensis*), annual meadow-grass (*Poa annua*), radishes (common long red variety), which were regularly watered with these solutions during two months.

"Plants of *Anthoxanthum odoratum* (sweet-scented vernal), were killed by a solution containing 24 grains of salt per pint, after the lapse of one month.

"2. Such weak solutions appeared to benefit most plants experimented upon, especially

cabbages, radishes, and lentils. All had a fresher and more luxuriant appearance than those watered with rain-water only. The lentils, which were watered with a salt solution containing 24 grains per pint, were nearly one-half larger in size than those watered with 6 grains of salt to the pint, and these again appeared more vigorous than the lentils which received no salt at all.

"3. Salt solutions, containing 48 grains of salt, exercised a prejudicial effect in the course of a month on lentils, chickweed, groundsel, and the annual meadow-grass.

"They had no injurious effects on cabbages, field beans, onions, radishes, and thistles.

"4. Salt solutions, containing 96 grains of salt per pint, exercised an injurious effect upon cabbages and field beans; but did not injure onions, radishes, and thistles, regularly watered with such solutions during two months.

"5. Cabbages will continue to grow, though sickly, when watered regularly during a month with a salt solution, containing 192 grains of salt per pint, and even when watered with a solution containing 384 grains of salt per pint.

"6. A solution of salt containing 192 grains per pint proved now prejudicial to onions regularly watered with it during one month.

"7. A solution containing 24 grains of salt to the pint decidedly benefited radishes, onions, lentils, and cabbages.

"8. Grasses are affected by salt more readily than any other of the plants experimented upon.

"9. Bulbous plants, and plants with succulent leaves, are especially benefited by the application of salt.

"Many of the plants, in these experiments, had taken up so large a quantity of salt, that they tasted quite saline; but, notwithstanding this, they grew healthily. This evidently shows that salt, in a moderately diluted solution, can be taken up by many plants without exercising a pernicious effect."

In the garden, salt is advantageously employed to prevent worm-casts on lawns; for this purpose it may be used at the rate of from 6 to 10 bushels per acre. Strong solutions of salt are likewise commonly used for the destruction of weeds on walks.

As a manure for onions, turnips, carrots, beans, lettuce, cabbage, parsnips, potatoes, and beet, salt has been successfully employed. Asparagus, which grows naturally near the sea, is greatly benefited by the application of

salt, and as much as 20 lbs. to the rod have been used without the slightest injury to the plants. Indeed, salt is a necessary addition to the soil wherever marine plants, or such as naturally grow near the sea, are cultivated.

In very small quantities, salt has been applied with good effects to hyacinths, and other bulbs, also to carnations.

The soils to which the application of salt proves most beneficial are those which contain it only in small quantities, or which are at a considerable distance from the sea. Soils in which natural deposits of salt exist, and land situated near the sea, and which is exposed to sea breezes, always contain a sufficient quantity of salt, and to such soils its further addition will not only prove useless, but positively injurious. In consequence of the evaporation from the sea, the clouds formed above it always contain more or less salt; and these clouds passing a long distance inland, condense, and the salt is brought down with the rain. On this account, in islands and countries situated near the sea, salt is always of less value as a fertilizer than elsewhere.

The quantity of salt per acre that may be used with safety, must necessarily vary according to the soil and the kind of plants which is to be grown on it; but, in general, from 5 to 10 bushels may be considered a safe application, always provided, however, that the soil does not already contain it in sufficient quantity. Salt is generally used as a top-dressing, and sown by hand, in which way its more even distribution is insured; it may also be advantageously mixed with earth and lime, or with soot or other manures.

When salt is mixed with moist earth and lime, a considerable quantity of carbonate of soda and chloride of calcium is produced, owing to the salt being partially decomposed, the chlorine of a part of the salt uniting with the lime, whilst carbonic acid supplies its place, forming carbonate of soda. This having the property of combining with silica, and rendering it soluble, may prove beneficial to plants, by supplying them with that essential article of their food. It is probable that the beneficial effects resulting from the application of salt, may be in some measure due to this decomposition taking place in the soil, and to the consequent formation of a soluble compound of silica, namely, one of the silicates of soda. Salt, likewise, is found as such in nearly all plants: part of its fertilizing action is, there-

fore, to be attributed to its supplying plants with this article of their food. Besides, this salt acts as a source of soda, and probably also of chlorine.

Kelp is the ash obtained by burning sea-weeds, and contains a large quantity of potash and soda; hence it was formerly the source from which carbonate of soda was obtained; but this is now extracted from common salt, which has superseded kelp for this purpose.

The composition of kelp from Rona and Heisker, is exhibited in the following analyses by Dr. Ure:—

	Rona.	Heisker.
Carbonate of soda,	55	85
Sulphuret of sodium,		
Sulphate of soda,	190	80
Chlorides of sodium and } potassium,	375	365
Carbonate of lime,		
Sulphate of lime,	95	—
Alumina and oxide of iron, ...	100	90
Silica,	—	80
Sulphur and loss,	85	60
	1000	1000

—(Solly's *Rural Chemistry*.)

From the above analyses, it appears that kelp contains many of the inorganic substances required by plants for their food. The beneficial action of kelp is chiefly due to the supply of potash, soda, and sulphuric acid which it affords. Some sorts of kelp contain a small amount of phosphoric acid; when this is the case, their fertilizing effects must be greatly increased. Kelp is generally applied to the greatest advantage together with organic manure; and where circumstances will permit, it is better to use sea-weed in its fresh state, than to make it into kelp, for in that process the valuable organic matter is destroyed.

CHAPTER VII.

TOOLS, INSTRUMENTS, MACHINES, &c., USED IN GARDENS.

Many of the tools used in gardens are so familiar to almost every one, that a mere enumeration of them might be considered sufficient; yet the difference between a good and a bad one, both being employed for the same purpose, is of great importance. The spade is one of the most commonly used implements, and it is not, perhaps, too much to say, that

with one of the modern improved kinds, a man could do, with the same exertion, 10 per cent. more work than he could with the comparatively dull working kinds formerly in use. But, besides the advantage from more work being performed, it is always the case, that with a well adapted tool of a superior description, the work is also better done. On this account, tools that are very common are, nevertheless, noticed, in order to point out the good properties which they ought to possess.

I.—TOOLS.

Spades.—Of all tools employed in gardening, the spade is the most essential. With it alone most kitchen garden crops could be obtained, and plantations of fruit and forest trees could be formed. If a gardener were limited to the choice of only one implement, that which he would retain as the most useful, would be the spade.

Fig. 43.



Lyndon's Spade. steel facing, the latter forms a sharp edge.

The English spade has long been justly considered as the best in the world; and it was thought that the utmost perfection in its manufacture had been attained. Great improvements have, however, been effected of late years. In Lyndon's patent (Fig. 43), the face of the spade consists of a thin and exceedingly hard layer of steel, the back is comparatively soft; and as it wears from the steel facing, the latter forms a sharp edge.

Shovels.—These being broader and lighter than the spade, and having the edges turned up, are better adapted for moving loose soil, gravel, or sand. The handle should have an upward bend, less stooping being then required in using the tool.

Picks.—There are several varieties of these, some having pointed, others cutting ends. As they are used for penetrating and loosening hard soils or gravel, or for cutting roots among sandy or stony particles, these implements require to have their ends well steeled and tempered.

The *Common Pick* has both ends pointed, and is curved, the curve nearly corresponding with the segment of a circle, of which the radius is somewhat greater than that of the

curve described by the pick in making a stroke.

The *Pickaxe* is pointed at one end like the common pick; but the other end is wedge-shaped, and sharpened so as to cut roots of trees, &c., like an axe. The cutting edge is in the direction of the handle.

Another form of pick, sometimes called a *mattock*, or *planter's mattock*, has one end pointed, and the other flattened, the edge being transverse, or at right angles to the direction of the handle. The length of the head may be from 24 to 30 inches, that of the handle about 3 feet, and the breadth of the flattened end from 3 to 4 inches, or by relaying, it may easily be made wider, if the work to which it may be applied render such desirable. This kind of pick is perhaps the most useful, and if only one sort were allowed, this should be preferred.

Mattock, or *Grubbing-axe*.—This is brought to a thin wedge shape at both ends; but one edge is in the direction of the handle, and the other transverse to it; so that it combines the two previously described implements as regards the direction of the edges, but has not the pointed end which they each possess for penetrating among hard compact substances. It is, however, well adapted for grubbing up trees; with the flat end facing the operator, the roots may be uncovered, undermined, and sometimes more conveniently cut, than with the opposite end.

The *Hoe-axe*, also called a grubbing-axe or mattock, is somewhat similar in its structure and application to that of the transversely flattened end of the preceding implement. It is like a long narrow hoe, but strongly made, and is fixed on a longer handle than that of the pick, and may be employed for cutting up bushes, &c. It is, however, seldom used in gardens in this country.

The *Pickfork* (Fig. 44), also known as the Canterbury hoe, is useful for loosening the soil when it has become hardened from the effects of rain and sun. By means of the fork end the surface may be broken up, and when this is too hard, or when clods have to be broken, the mattock end may be employed.

Rakes.—A set of iron-headed rakes, of different sizes, are required.

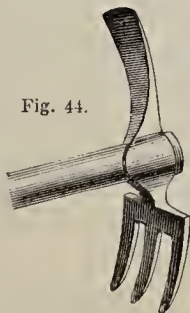


Fig. 44.

Pickfork.

The length of the head may be about 16 inches for ground that is either uncropped, or occupied with plants widely apart. The sizes may diminish by 2 inches in the length of the heads, so that the latter may be respectively, 14, 12, 10, 8, 6, 4. The last will be convenient for raking between crops sown in rows, and for using between plants in flower gardens. In the latter case, raking by drawing the teeth along the surface between the plants is frequently not so much required as a kind of chopping, so that the teeth may break down the clods. It is a great mistake to use a rake that merely passes between the plants; for when this is the case, the implement cannot be freely plied, and, consequently, the work can neither be so well nor so quickly performed.

When the teeth of iron rakes are driven into the head-bar through merely a square punched hole, and then clenched above, they are apt to break off level with the under side of the bar. The liability to this is, however, greatly diminished by forming a shoulder on the tooth to fit a slight counter-sink made in the under side. Rakes are sometimes secured to the handle by a prong which is driven into the iron-ferruled end of the handle. The soil, however, is apt to adhere about the lower end of the handle. It is, therefore, better that the handle should taper into a neat socket, the upper side of which tapers into a strap.

Rakes with cylindrical wooden heads, into which iron teeth are driven, are occasionally used for smoothing the surface of beds for seeds. Wooden rakes, the same as the common hay-rake, are required for raking off grass and leaves. Others, of a similar description, but made with greater care, and with teeth of tough hard wood, may be sometimes employed with advantage in light soils, instead of iron rakes. Being much larger but lighter than the latter, they can be more easily drawn over a surface of greater extent. Wooden rakes, with short close teeth, may be made to take off short grass from lawns so cleanly, as sometimes to render sweeping unnecessary.

The *Daisy-rake* (Fig. 45) has broad teeth,

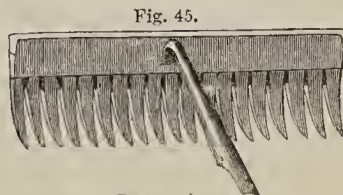


Fig. 45.

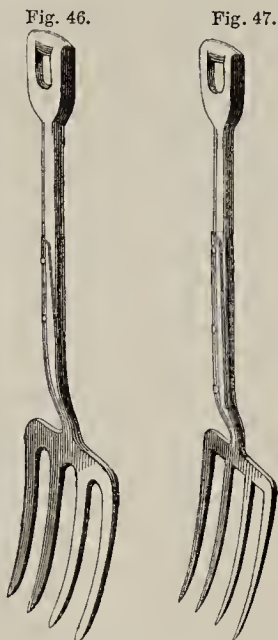
Daisy-rake.

sharp on both edges; it is employed for re-

moving the flowers of daisies and other plants from lawns.

Forks are employed in gardens for stirring the soil, turning dung and tan, and for various other purposes.

Parkes' steel digging forks (Figs. 46 and 47), are superior to all others for stirring the soil; and this they do so effectually, that they are in many cases substituted for the spade. These forks may also be used for turning tan, and for taking up certain crops. The prongs are made of steel, they are elastic, and taper to a point; and the whole weight of the fork part does not exceed 5 lbs. It is made with three, four, or five prongs, and of various sizes.



Parkes' Steel Digging Forks.

The dung-fork has three prongs; it is necessary for turning and removing dung and litter, and for shifting and turning dung linings.

A small short-handled fork with three prongs (Fig. 48), is employed in pits and frames; it may also be used for taking up roots, and in weeding.

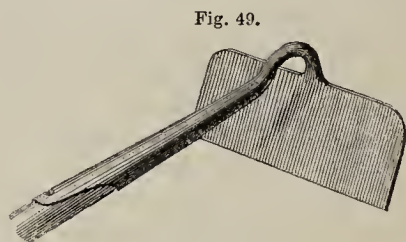


A fork for leaves, which is very useful wherever any great quantity of these is to be collected, has been invented by Mr. Toward, gardener to her Majesty at Osborne. Mr. Toward states (*Gardener's Chronicle*, 1843, p. 38), that one person with this implement will take up, with greater facility, more leaves than two persons could do with any other tool that he had seen used for the purpose. Mr. Toward describes it as being a large four-tined fork, made of wood shod with iron; the tines are 18 inches long, and are mortised into a head about 17 inches long, and $1\frac{1}{2}$ inch by $2\frac{1}{4}$ inches thick. The tines are 1 inch in width, and $1\frac{1}{2}$ inch in depth at the head, gradually tapering to a point, with a curve or bend up-

wards. The wood of which they are formed ought to be hard and tough, either oak or ash will do; but the *Robinia Pseud-acacia*, or locust-tree, is preferable to either. The head should be made of ash, with a T-handle of the same, and should be 2 feet 4 inches long. Its recommendations are its size and lightness; the leaves also do not hang upon it as on a common fork, the large size of the tines tearing them asunder. We consider this fork to be superior to any other for collecting leaves, and it deserves to be better known and more generally adopted.

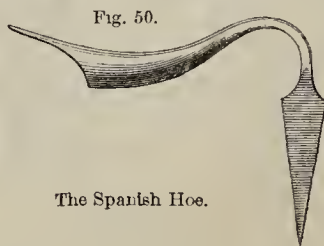
Hoes.—Of these there is a great variety of forms and sizes adapted for introduction among plants requiring to be grown at greater or less distances; also for light and heavy soils, for drawing furrows or drills, thinning crops, stirring the soil between the plants, and for earthing up, &c. Some of these are draw-hoes, others thrust, and a form combining both modes of operation has been used.

Draw-hoes have generally been made with a short neck and circular eye, through which the handle is fixed; but the latter is now preferably inserted in a socket, which is connected with the blade by a solid neck more or less curved, as in Fig. 49. This is a great improvement; for the soil does not clog the iron neck as it does the wood, the latter affording a larger surface; and, besides, soil of an adhesive nature is compacted in the angle between the



Crane-necked Hoe.

blade and the handle; but where there is no such angle, as is the case with the crane-neck, the soil cannot hold on. The blades of hoes should be made of steel plates, which can now be *shut*, that is, welded on iron necks, a process formerly



The Spanish Hoe.

reckoned difficult, if not impossible. The length of the plates for the largest need not exceed 9 inches; hoes for onions, &c., are required as small as 2

inches, and the Spanish or Vernon hoe (Fig. 50) is pointed. Some have the upper corners slightly rounded; others are made semicircular, or nearly so, and are called *half-moon* shaped. The less, however, the line of draught by the handle is raised above the edge, the steadier will be the cut, and the less easily will the implement be turned aside. Therefore, it is better that the plate should be a segment less than a semicircle. Hoes of a triangular form are used for drawing drills, and sometimes for this purpose the implement is made like a hollow trowel, the convex side being towards the handle.

The Dutch or thrust hoes, are useful for cutting down weeds, and for very shallow work on an even surface; but they are not so good as the draw-hoe when the ground is stiff and lumpy. The Dutch hoe can also be used to a considerable extent without going out of the alleys, so that the ground is not trodden as it is in using the draw-hoe.

A hoe combining the actions of the thrust and draw hoes has been used; the plate has a cutting edge back and front. The handle is placed so that when raised by the man to the most convenient height for operating, the plate lies flat on the ground. Above this height the handle must, however, be raised when the implement has to be pushed forward, in order that the fore-edge may enter below the surface. After being pushed forward, the handle must be depressed below the most advantageous position for working a draw-hoe, in order that the back edge may get hold of the soil. This alternate raising and lowering of the handle not only occasions a loss of time, but also a loss of power, in consequence of the handle being moved out of the position most advantageous for the workman, when making either a thrust or draw.

Turf-spades may be much more advantageously used for cutting turf than the common spade. The sort which appears to answer the purpose best has a heart-shaped blade and a bent handle. Before using this tool, however, the turf must be cut into strips by a turf-raser. Some turf-spades have one edge of the blade turned up, and made quite sharp, so that the turf may be cut and raised at the same time.

Turf-raser.—A very simple form of this is found to answer exceedingly well in the hands of those who cut turf for lawns in the neighbourhood of London. It is merely a stick

bent at the end, where a straight knife blade or cutter is inserted. The bent part forms a sole, which is pushed along the surface by a line, whilst the blade cuts the turf to a uniform depth. Wheel verge-cutters are also used for cutting turf into strips, and this they do with great rapidity.

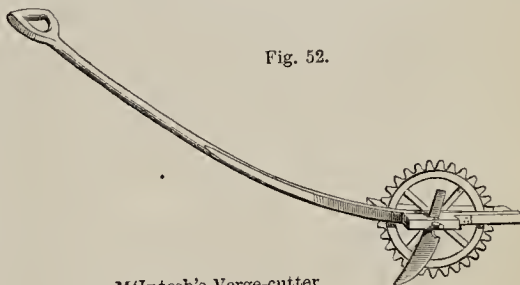


Verge-cutter.

Edging-irons or *Verge-cutters*.—A good simple form of these (Fig. 51), consists of a crescent-shaped steel blade fixed by a socket to a wooden handle. This sort of verge-cutter is better adapted for the outlines of small figures than any other, as its action is more immediately guided by the hand.

The wheel verge-cutter consists of a circular blade of steel, with a very sharp edge, and turning upon an axle fixed in a handle. When blunted, they are, however, very difficult to sharpen.

M'Intosh's verge-cutter (Fig. 52), is well



M'Intosh's Verge-cutter.

adapted for cutting the grass edges of walks, and performs its work with great expedition; and by replacing the coulter, whenever it becomes blunted, with a fresh one, the implement may be used a whole day without interruption on account of sharpening.

Turf-scraper.—In lawns where ants abound, and where their hills, or where worm-casts require to be taken off, a long light scraper of wood or iron, such as that used for roads, may be usefully employed.

Dibbers.—These are generally made of the upper part of old spade handles. Being made of hard wood, they are sometimes used without being shod; but where these implements are extensively used, the whole of the cylindrical part is sheathed in steel. This maintains a more polished surface than iron, and therefore perforates with less friction. For-

merly a little at the point only was shod, and in some conditions of the soil this is preferable. For example, when the soil is adhesive, the metal leaves a polish on the sides of the hole, which, if dry weather set in, prevents the roots from penetrating so freely as they would when the wood leaves the sides of the hole rougher or more porous. A piece of wood kneed, or bent at right angles at the top, to form a handle, is sometimes used. For inserting cuttings, small rounded tapering pieces of wood are employed.

The *Potato-dibber* is adapted for making a hole sufficiently large for allowing the set to drop to a proper depth. It has a cross handle at top, which can be grasped with both hands, and a projecting piece of iron or wood, serving as a tread for the foot to press the dibber into the ground. The tread might be made so that it could be shifted, and fixed higher or lower, according as the hole requires to be made of greater or less depth.

Garden Trowel.—The common garden trowel below the handle and neck is like the curved portion of the section of a cone. It is now made of steel, united to a curved iron neck. It is used for many purposes; but chiefly for taking up plants and replanting them, with balls of earth adhering. It is superior to the dibber, for by the latter the roots are crowded and pressed together; but by the trowel a hole can be made to admit of the roots being spread out.

The *Turf-beetle* is a flat oblong piece of wood, used for levelling and consolidating newly laid turf. It may be formed of a portion of 3-inch deal, secured from splitting by two iron plates, and having a handle inserted in the upper side. But this is often done in a manner very disadvantageous for the workman, and for effect on the turf. This is chiefly owing to the handle being fixed too upright, so that when raised up and brought down, it strikes on its heel or the edge nearest the workman, instead of pressing equally on the turf with its whole under surface. The handle should, therefore, be fixed at a sufficiently acute angle with the sole of the beetle, to admit of the latter being easily brought down flat.

Rammers are frequently required for ramming the earth about posts, tree-guards, &c., and for consolidating turf and gravel. They are generally made of wood, in the form of the base part of a cone, and have an upright

stem, into which two handles are inserted for lifting. Rammers with cast-iron heads are also sometimes employed.

Rollers.—A heavy cast-iron roller is required for broad walks, gravel areas, and for lawns. In flower gardens, or where the walks are narrow, or their turnings intricate, a narrow roller must be employed. A light wooden roller is used in the kitchen garden for rolling the ground when sown with onions, &c.

Brooms.—Those used for sweeping lawns, walks, &c., are generally made of birch twigs. They are tougher and last much longer when the birch is cut early in winter, or before the sap rises. They should, therefore, be made, or procured from the maker's, before this takes place, and should be kept in a moderately dry, airy place, where they will not be liable to mould.

Transplanters are sometimes used instead of the trowel or spade, in removing plants of small size with a ball. Two semicylindrical plates of iron with handles, and fastened together, so that they may be separated at pleasure, may be employed for the purpose. The mode of using this instrument is very simple. The plant to be raised is inclosed by the cylinder, which is formed by the two pieces; this cylinder is then pressed or worked into the soil, and on being pulled up by the handle, it brings up the plant together with the earth surrounding it. The planter is placed in the hole prepared for the plant, the fastenings are removed, and the sides withdrawn, the soil being pressed round the ball at the same time to prevent its breaking. In this way a plant may be removed at any period of its growth without injury resulting to it from the operation.

There are various other transplanters, mostly modifications of the preceding; some consist of a cylinder for raising the plant, fitting into a bottom, to prevent the earth from falling away; others have blades, which, after having been forced into the ground, may be tightly closed by means of handles upon the soil surrounding the plant. The above transplanters are only adapted for lifting plants of small size. They are not much used in gardens, the trowel and spade being generally substituted for them. The contrivances employed in removing plants of large size, will be adverted to in the chapter on transplanting.

Suckering Iron.—One that answers well for removing suckers from gooseberries, currants,

or other trees, is represented in Fig. 53. It consists of a chisel-like steeled blade, 6 inches long, $2\frac{1}{4}$ inches broad at the edge, and $1\frac{1}{8}$ inch at the shoulder, where it tapers to a straight round iron shank, the upper part of which forms a socket for the insertion of a wooden handle. The length from the edge of the tool to the top of the socket is 34 inches, and from that to the top of the wooden handle 10 inches, the whole length being 3 feet 8 inches. The edge is usually straight, and is apt to slip past the sucker; but the figure represents an improvement made by Mr. Thornton, of Turnham Green, the edge being concave.

Fig. 53.



Sucker
Iron.

The *Dock-weeder* is employed for taking up such deep tap-rooted weeds as docks; it consists of an iron blade, with two prongs fixed in a handle, like that of a spade; a curved piece of iron on the back serves as a fulcrum; and in some forms of the implement, a projecting knob answers the same purpose.

Crow-bar.—The usual form of this is a round straight bar of iron, with a pommel top; the bar is thickened a little towards the lower end, near which it is square, and then tapers to a point. It is useful for making holes for stakes; and being sometimes made flattish and wedge-shaped at the end, it is occasionally employed as a lever for loosening the soil below trees that are to be removed. For large stakes, the lower part of the bar is formed like a short inverted pyramid, and the whole implement is not longer than admits of its being struck on the top with a sledge hammer or heavy mallet.

Hammer.—The principal use of a hammer in gardening is for nailing wall-trees. For this purpose the head should be rounded to serve as a fulcrum in drawing nails, and in this operation the claws should hold the nails without slipping, a property which too many of the hammers used for the purpose only possess in a slight degree. The head, also, should not be too long, otherwise, in drawing nails, it is apt to bruise adjoining branches, where these happen to be close together.

Mallet.—This is necessary when branches are to be cut off by the chisel, or where that instrument is employed to smooth the place where branches have been cut off by the saw. Different sizes are required for driving stakes,

and other purposes. Large ones ought to be secured by an iron hoop round each end.

Pincers are requisite for drawing nails, and other purposes. When the lid of a packing box is taken off, the nails can be readily taken out by means of the pincers and hammer, without breaking off the points of the nails, or bending them, so that they cannot be drawn without tearing the wood. If the nail projecting through the under side of the lid be firmly grasped with the pincers, say half-way between the point of the nail and the under side of the board, and the opposite side of the board, near the head of the nail, be struck with the hammer, the former will be driven up so that the pincers can lay hold of it. All the nails being successively drawn in this manner, the board or lid will be fit for being again nailed on when required.

Pliers are occasionally required for drawing and twisting wire, and for this the blades, where they approach each other, should be flat. Cutting pliers are very convenient, being adapted, not only for drawing and twisting, but also for cutting wire.

The *Screw-driver* is necessary in a garden, chiefly for screwing down and unscrewing the lids of boxes; and it is indispensable wherever screws are employed for other occasional purposes.

The *Implement-cleaner* is a small wooden spatula, used for cleaning spades and other implements. It is indispensable in working adhesive soils, where the tools become clogged. It may be formed out of a bit of thin deal by the workman, and of any form that he may prefer.

II.—CUTTING INSTRUMENTS.

Knives, of various kinds, are required in gardens, for pruning, budding, grafting, and other purposes.

The *Pruning Knife* is the best instrument that can be employed for pruning trees and shrubs; besides which, it may be used for a variety of other purposes. Pruning knives are made of various forms; the blade, in some kinds, is made with a joint, so as to fold in; and in others, it is fixed immovably in the handle, and kept in a pasteboard sheath when not in use. Knives, with folding blades, possess the advantage of being more portable, and are therefore more convenient for occasional use; whilst, on the other hand, those with

fixed blades are more steady in their action; and when constant pruning is carried on, are preferable. The handle should be made of buck's-horn, the rough surface of which prevents the hand from slipping. With regard to the shape of the blade, some prefer blades with straight edges; others, those the edges of which are more or less curved. For removing small shoots, a straight edged blade is preferred, for a cleaner cut is produced; but

where branches are to be cut off, a curved blade can be used with greater effect. A pruning knife, like the one represented in Fig. 54, which has been selected from a great variety of patterns, manufactured by Messrs. Saynor and Cooke, of Sheffield, we consider preferable to all others for general pruning and other purposes. It has a slightly curved blade of well-tempered steel, and a considerable portion of the edge is straight, being only a little curved near the point. This



Pruning Knife.



Grafting Knife.

is an advantage; for in drawing the cut, the pressure against the wood diminishes as the cutting part is moved further from the handle, and this is, in a great measure, compensated by the curve near the extremity of the blade.

The *Grafting Knife* (Fig. 55) has a thinner and narrower blade than the pruning knife, which, however, may frequently be substituted for it.

The *Budding Knife* is made in various forms. The blade is generally either straight-edged or curved backwards towards the point. The handle, which is made of ivory, is usually rounded and thinned off at the end, in order

that it may be used for raising up the bark. The end of the handle is sometimes made heart-shaped, and this form admits of the bark being

Fig. 56.



Fig. 57.



Budding Knives.

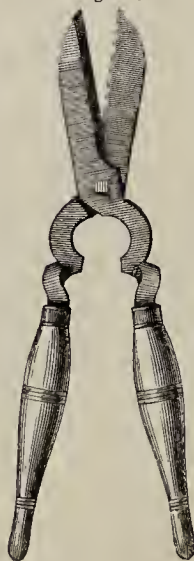
raised with greater facility. Instead of the handle being thinned at the end, some knives have a common handle, and a small piece of ivory which folds in for the same purpose. Figs. 56 and 57 represent good forms of budding knives.

The *Vegetable Knife* has a larger and more curved blade than the pruning knife. It is chiefly employed for cutting vegetables and dressing off their rough leaves.

Shears are required in gardens for clipping hedges, grass edgings, and for pruning.

Hedge Shears.—A good form of these is represented in Fig. 58. The dimensions are as follows:—The length of the blades, from the pivot to their extremities, is $10\frac{1}{2}$ inches; the

Fig. 58.



Hedge Shears.

breadth of each is 2 inches. The length of the handles is 12 inches; and when the blades are placed level, the under part of the extremity of the handle is 3 inches above that level. About $1\frac{1}{4}$ inch of the edge next the pivot is formed circular and convex in the one blade, and correspondingly concave in the other. This admits of branches being grasped and easily cut from being near the fulcrum, and is therefore very convenient for cutting snags, or branches

that may be occasionally met with, and which prove too thick for being otherwise laid hold of, except at too great a

distance from the fulcrum or pivot, to have a sufficient purchase.

Parrot-bill Shears are employed for grasping and cutting stronger branches than can be

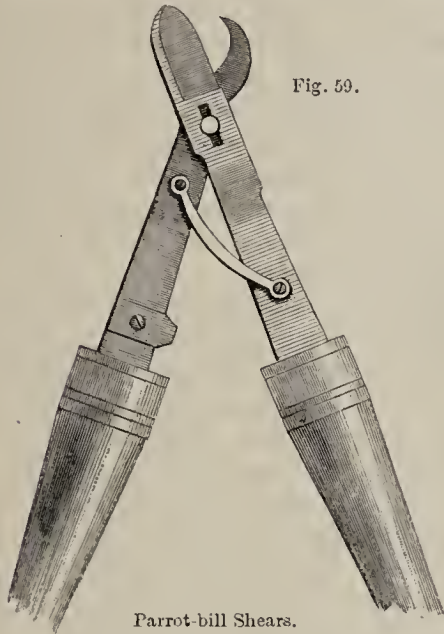


Fig. 59.

Parrot-bill Shears.

done with the ordinary hedge shears. They are made with or without a slide space at the pivot, as seen in Figs. 59 and 60. They should be fixed into strong wooden handles,

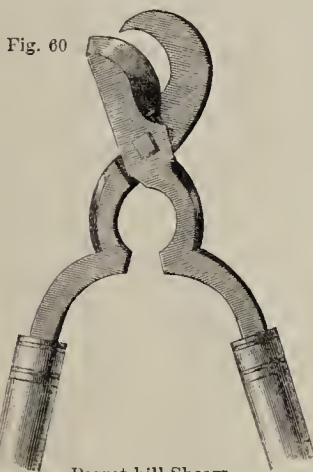


Fig. 60.

Parrot-bill Shears.

about 3 feet in length, and broadly ferruled where the prongs are inserted.

Grass-edging Shears.—Some kinds of these are furnished with a small wheel to run along close by the edge of the grass; but the form represented in Fig. 61 is less complicated, and is, on the whole, probably best adapted for general use. This kind of shears was formerly made with the handles at right angles to the blades; but the handles should form with the edges of the blades an angle of 110° , being 20° wider than a right angle; or the top of

the handle, nearly 3 feet in length, will be about 11 inches back from the perpendicular. The axis or pin on which the blades turn should have a smoothly rounded head

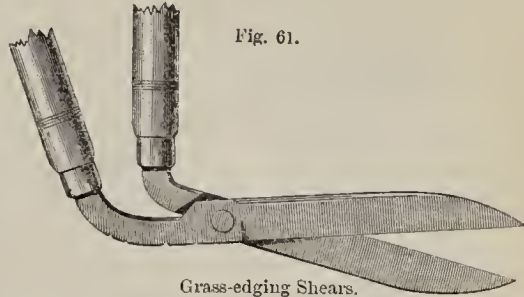


Fig. 61.

Grass-edging Shears.

next the edging, that is, on the left-hand side. The other end of the axis should have a screw and nut with a washer; or there may be two thin nuts worked hard against each other, to prevent their being turned by the movement of the blades. It is necessary that the end of the screw should be on the right-hand side, otherwise it would catch against the edging.

Pruning Shears.—There are various sizes of these, according to the greater or less thickness of the shoots or small branches to be cut off. The pruning shears shown in Figs. 62 and 63, are employed for the removal of the shoots of fruit-trees; and the centres being

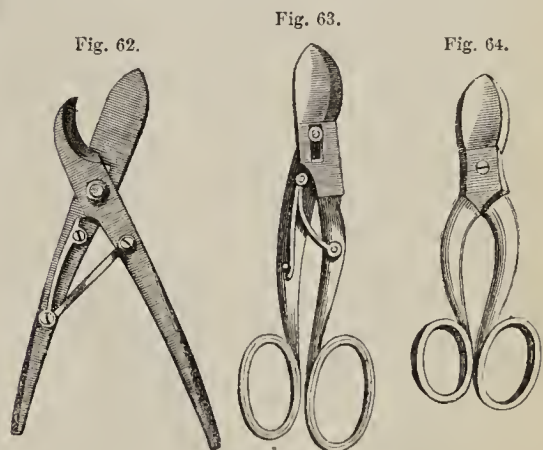


Fig. 62.

Fig. 63.

Fig. 64.

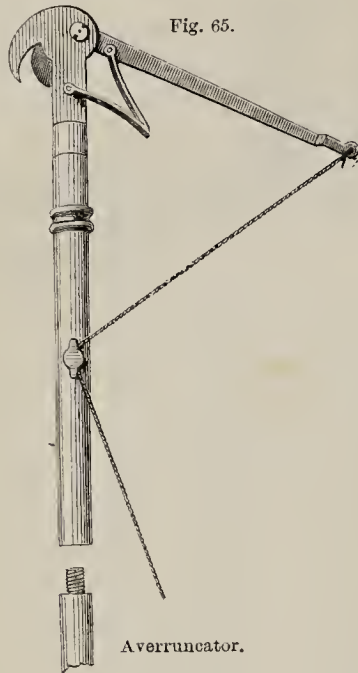
Pruning Shears.

moveable, they produce a draw cut like a knife, instead of a crushing cut like that of the common shears.

The shears represented in Fig. 64 are useful for pruning gooseberries, currants, roses, and other plants. They are very strong and effective; and being made without a slide, are not liable to get out of order.

The *Averruncator* (Fig. 65) is used for the purpose of pruning standard trees, the branches of which are situated at a considerable elevation. There are several forms of this instru-

ment, differing slightly from the preceding; but they all consist of two blades, one of which is fixed to a handle, and the other is moved by a lever, to which a cord, passing



Averruncator.

over a pulley, is attached. By means of an averruncator, branches more than an inch in diameter, and at the height of 12 or 15 feet from the ground, may be cut off without using either a ladder or steps; and if these are employed, branches at a much greater height may be removed.

The *Sécateur* (Fig. 66) is an instrument, much used in France, for removing superfluous shoots. It possesses the advantage of being much more expeditious than the pruning

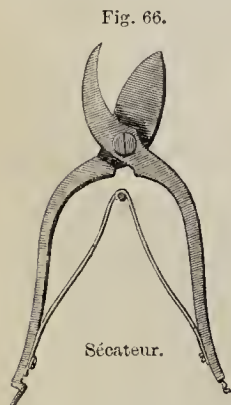


Fig. 66.

Sécateur.

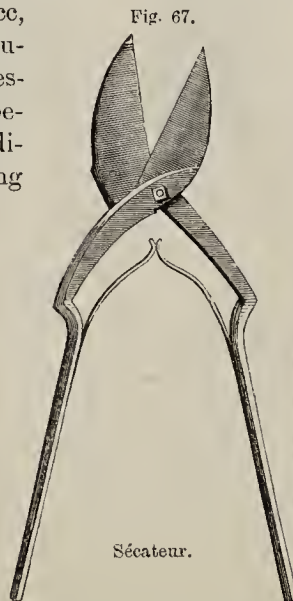


Fig. 67.

Sécateur.

knife, and when well made, answers nearly as well. It is well adapted for summer pruning,

and for shortening one-year-old shoots, particularly in the case of the peach tree, where the part left is at the next pruning entirely cut away. There are various forms of the *sécateur*. In some the pivot is fixed; in others, it slides. One of the latest modifications of the instrument is shown in Fig. 67.

Fig. 68.



Grape Scissors.

Both blades are flat, sharp, and straight-edged, so that the extremities of shoots nailed to a wall may easily be cut off without bruising the bark or taking out the nails.

Grape Scissors (Fig. 68) are used for thinning out the berries of the bunches of grapes. They should have small tapering points; but not too sharp, otherwise it is impossible to introduce them among the grapes without pricking some of the berries not intended to be removed.

The *Axe*.—One of a convenient size is useful for many garden purposes, such as sharpening stakes; and a large one, with a handle long enough to be used with both hands, is required for felling trees.

The *Hedge Bill*, or *Pruning Bill*.—This instrument is employed for dressing the sides of hedges. It is a slightly curved blade, attached to a handle about 4 feet long. Whilst the blade is applied in a direction corresponding with that of the side of the hedge, the handle deviates so far as to permit the opera-

Fig. 69.



Bill-hook.

Fig. 70.



Bill-hook.

tor to stand clear of the hedge.

The *Bill-hook* (Figs. 69 and 70) is used instead of the axe for cutting hedges, lopping branches, sharpening stakes, fagoting, and wherever the wood to be cut is of small diameter.

Chisels.—These are used for various horticultural purposes, for which different kinds are adapted. Some are similar to the carpenter's chisel, and are used for cutting off branches too strong for the knife, and situated where the saw could not work; and also for smoothing the cuts made by the saw or other instrument. Chisels, with handles 10, 20, or

even 30 feet in length, are occasionally employed for pruning; some are of the usual form, others have one or two reflexed ears for cutting, by pulling downwards any torn strip of wood or bark. When the handle is very long it requires to be made of sufficient thickness to prevent it from bending. It has, therefore, a considerable weight, and, consequently, its inertia offers much resistance to the blow, and would almost entirely counteract even a smart blow from a small mallet; one as large as can be properly wielded will be found most effective in this case. Long-handled chisels are very useful in pruning, especially for removing one of two competing leaders, in trees that are intended to be grown with single straight stems.

The *Grafting Chisel* is not flat on one side, and bevelled to an edge on the other, like the carpenter's chisel, but tapers on both sides, like a wedge. It is, in fact, used as a sharp wedge for splitting the stems or branches of trees, so as to admit of the graft being inserted—a mode of grafting by no means to be recommended; for the old wood, when once separated, never heals.

Scythe.—The usual form of scythe-blade answers for lawns, provided the neck is set with the handle to take in a wider sweep, and it should also be turned up so that the under side of the blade may be nearly flat with the surface of the ground. When worked by a person in the easiest position for making the sweep, the back should be close on the ground, whilst the edge should be slightly elevated. The common bent handles are as good as any, if not the best. Much depends on the placing of the two projecting handles for the grasp; their distance from the heel, and from each other, should be so regulated, that the blade, when lifted up clear off the ground, will balance parallel to the surface.

Boyd's Self-adjusting Scythe has a piece of iron, 4 or 5 inches in length, attached lengthwise to the under side of the handle. To the end of this another piece of iron is jointed, so that it may be moved out or in horizontally, and be secured at any required angle by a nut and screw. The heel of the scythe is made with an eye, and is secured to the end of the piece of iron last-mentioned, so that the edge of the scythe can be set higher or lower without the assistance of the blacksmith. The two joints are equivalent to a universal joint, and, in short, this is the prin-

ciple of the invention. There was some difficulty in securing the screw at the heel so as not to permit shifting. A ratchet and key was therefore added, to prevent the scythe from moving outwards on the joint. The facility with which this kind of scythe can be adjusted, renders it very convenient, and more especially so for those who do not understand the setting of a scythe by the ring and wedge. In sharpening a scythe, the stone should be drawn almost flatly along the under side, so that the edge may not be turned up; the upper side should be more bevelled.

The *Asparagus Knife* (Fig. 71) has a ser-

Fig. 71.

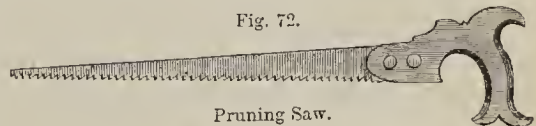


Asparagus Knife.

rated blade, with a long iron shank fixed in a wooden handle. The blade should be made of hard tempered steel. In using it, a little soil is removed with the blade from the side of the shoot, in order to discover the direction of the latter; the blade is then pushed down somewhat slanting, and the shoot is cut, or rather sawed off, near its base. In doing this, care must be taken not to injure the crown of the plant, nor other shoots that may be coming up.

Saws are required for various purposes in gardens and plantations; and, accordingly, several kinds are necessary. A cross-cut saw is required for cutting down trees; and for large limbs the saws used by carpenters will answer, only the teeth may require to be wider set if the wood is soft and full of sap. Pruning saws are most required for ordinary pruning; they are employed for cutting off smaller branches than the preceding, and not being so broad, are better adapted for cutting close to the fork of branches, or where a broader plate could not be introduced. The kind called *turning saws* (Fig. 72), such as

Fig. 72.



Pruning Saw.

are used for cutting out circular spaces in boards, answer exceedingly well, and being made of the clippings taken off in cutting out other saws, they are not expensive. In some cases, pruning saws with the teeth set with their cutting edges in the direction of the handle, so as to cut by drawing, instead of by

pushing forward, are of use, for these can be attached to a long pole handle, in order to reach high branches. In such cases, a saw with the teeth set in the usual way, would be apt to warp or break at every thrust; but one adapted to cut by drawing is not liable to this inconvenience.

Before saws used in pruning are laid aside, they should, in the first place, be perfectly cleaned from all juice, or other adhesive substance, that may collect upon their surface. They should then be well dried and oiled. They will also work more easily, and cut more expeditiously, and with less danger of breaking, if cleaned and oiled occasionally when in use.

Fruit and Flower Gatherers.—Of these there are several kinds. For gathering fruit situated at a considerable height, the averruncator, with a net attached, may be employed. The grape gatherer (Fig. 73) is useful for gathering grapes and other fruit, as well as flowers which are situated beyond the reach of the arm. It consists of a pair of scissors constructed on the principle of the wire-worker's pliers, so as to cut and hold at the same time. The scissors are kept open by a spring, and attached to a light handle. Previously to using the instrument, the collar is pushed up to the knob, and the spring causes the cutting part to open. By pulling the collar down by means of the cord attached to it, the blades are closed, the stalk is cut through, and the part cut off is held securely.



Grape Gatherer.

There are several other kinds of fruit gatherers adapted for gathering peaches, pears, and other fruits; but the hand is the most expeditious fruit gatherer we have, and it does not bruise the fruit if due care be taken.

III.—INSTRUMENTS USED IN LAYING OUT GROUND LINES.

Garden Line and Reel.—A garden line should be made of good materials, otherwise it soon gives way in stretching; but however good at first, a line will soon decay if rolled

closely up when wet. It should, therefore, be wound on a reel, which not only permits the line to dry more speedily than when closely rolled up, but also facilitates its being readily extended and recoiled. The reel has usually an upright pin, near one end of the upper cross bar, for turning the reel; but this projection should turn within a handle, and not be fixed in it. When taken up or let out by turning the reel, the line, in either case, is neither twisted nor untwisted in the operation; but if wound by hand on the reel, the line will be twisted either more or less than it was before; so that the strands of which the line is composed are alternately opened and closed, and it consequently loses on each occasion much of its original compactness and strength. If a line be tightly stretched when dry, and allowed to get wet without being slackened, it will either snap, owing to the contraction which takes place in twisted fibre when wetted, or it will be injured from the overstrain. When a line rests on the ground, its weight does not affect the straightness of the tracing; but when stretched and supported only between two points, with the intention of indicating a straight line between them, the line should combine strength with lightness, as, for instance, small whip-cord.

The *Chain* is indispensable where land, walks, or roads have to be measured, and it is always desirable that there should be one in a garden, at least if it is of considerable extent. The one commonly employed, and which is used by surveyors, is called Gunter's chain. It consists of 100 links, each of which is 7.92 inches in length, consequently, the whole length of the chain is 66 feet, = 22 yards, or 4 poles. The long links should be connected by short oval ones, for these are not so apt to stretch as round links. If an oval link should be compressed, its length will still be much the same; but if a ring be at all compressed so as to alter its form, it must assume an oval shape, and, consequently, the chain will be too long. Chains should be occasionally verified, and all bent links made straight with a wooden mallet.

One great advantage of using the chain consists in the facility with which areas calculated in links may be reduced to acres; for as there are 100,000 square links in an acre, we have only to point off five figures to the right, and the equivalent area in acres and decimals of an acre is obtained; thus, if the area be

118,960 links, by pointing off the five last figures we have 1.18960 acre. Accompanying the chain are ten small arrows, about 15 inches in length, the use of which is to mark the termination of each chain's length. A staff having been set up to show the direction of the line to be measured, a person, called the leader, takes one end of the chain, holding at the same time the ten arrows in his hand, and proceeds in a straight line towards the staff. The other end of the chain is held by the surveyor, who directs the leader till the chain is stretched in a straight line in the direction of the staff. When this is done, the leader fixes an arrow in the ground at the end of the chain, and again starts off till another chain's length is measured, the chain is then directed and stretched, and an arrow fixed in the ground as before. The surveyor picks up the first arrow, which he retains, and continues picking up the arrows as the measurement progresses: when the surveyor holds ten arrows, they are returned to the leader, and the circumstance noted. The leader then starts afresh, and the measurement is continued in the same way, till the whole distance has been measured. Each change is then counted as 1000 links, every arrow the surveyor holds in his hand as 100 links, and to this is added any links that there may be over; the sum will be the length of the line in links. Thus, if there have been two changes, and the surveyor hold five arrows, and there be 13 links more, the length of the line measured will be 2513 links.

Measuring-rods.—Without measures of some sort, there could be no regularity in gardens; walks and borders could not be lined off to their proper width; the ground could not be portioned out for the different crops; nor could trees, &c., be planted at proper distances, without some metrical instrument.

Two thin rods, such as are used by surveyors, would be useful for very particular dimensions; but for common use in the open ground, they would be liable to be broken in carrying along with other implements. A 10-foot rod, of clean, well-seasoned deal, about $1\frac{1}{4}$ inch square in the middle, but tapered at each end to less than an inch square, may, for common purposes, be substituted. A copper fastening should be put round each end, to prevent splitting and wearing. When tapered so that the ends are lightened, the rod will neither bend nor readily break; but it cannot be used

as a straight-edge, which is sometimes required. A rod may therefore be made $1\frac{1}{2}$ inch broad, with parallel straight edges, and $\frac{3}{4}$ inch thick in the middle, but thinner at each end.

It is often necessary to measure ground work and garden allotments by the pole or perch. For this purpose, a measuring-rod, $16\frac{1}{2}$ feet in length, divided into 100 parts, will be found exceedingly convenient; for the length in rods and parts set down as decimals, has only to be multiplied by the breadth set down in a like manner, and the area is at once obtained in rods and decimals of a rod.

Stakes.—For marking out lines for walks, boundaries, and divisions, stakes are necessary, and may be reckoned amongst the first requisites for the laying out of gardens. They are, in fact, necessary on many occasions, as when plantations, edgings, and lines have to be made out afresh. Stakes for these purposes should be made of clean, well-seasoned deal; they should be 6 feet in length, 1 inch square, quite straight, and the lower end regularly pointed. When not in use, they should be kept in a dry place, strapped together in bundles, ready to take out whenever they are wanted. If thus taken care of, a set will last for a great number of years, and the first cost will be little compared with the loss of time in searching after and preparing such as can be hastily obtained on every occasion that stakes are indispensable. The above description of stake will be found useful where ground has to be levelled, as both the original and intended surface lines can be relatively marked on them. But before the ground work is commenced, a shorter and stouter description of stake should be employed, so that it will bear to be driven in so firmly as not to be easily moved whilst the work is going on.

Borning-rods.—These usually consist of three straight rods of equal length, each with a cross-piece at right angles across the top. They are used for determining points that shall be either in a horizontal or uniformly inclined plane. For example, supposing the edging of a walk is required to run straight between two fixed points; then, if we place a borning-rod on each of these points, and another anywhere between, by looking over the top of one at either end, we may direct the person holding the intermediate rod to raise or lower it, as the case may be, till it is seen to be in a line with that at the further

end. For ordinary purposes, the above construction of rods will answer tolerably well; but in using them, an imperfection is experienced, which may, however, be easily remedied. In looking over their tops, a fringing of the rays of light on the edges prevents the latter from being exactly seen. The following construction is therefore recommended.

Instead of the three cross pieces being of the same width and height, one of them should be about an inch broader and higher than the others. If two have their upper edges, say 4 feet from the bottom of the rod, the upper edge of the other may be 4 feet 1 inch; but a line should be drawn exactly at 4 feet. A very small hole should be pierced through the cross-piece, to form a sight; the sides of the hole should be smooth and blackened, as should likewise be the cross-piece, but not varnished. The hole should not be wider than would admit a small pin. On looking through it, the top of the intermediate rod can be easily and much more correctly placed in line with the top of the further rod, than by looking over the tops of the three.

Usually three persons are employed in striking either a level line or regular slope between two points, or one person for each rod. The one between the two extremities is directed by one of the others to raise or lower the ground till his rod is seen to be in line. A number of intermediate points have usually to be determined in the same way. Instead, however, of three men being occupied, one will be sufficient with the above improvement, after an intermediate point has been ascertained. At that point a stake or rod should be placed with a card fixed across, with its upper edge in line with those at the extremities. Having obtained three fixed points, a workman can then raise or lower a rod till he find it in line with two of those previously ascertained. By using the rod with the sight hole, he will also be able to work with greater exactness.

Ground Compasses.—These may be occasionally used very conveniently in making geometrical flower gardens. They are constructed on the same principle as the common compasses, with the segment gauge used by mechanics. The legs are made of hard wood, 5 or 6 feet in length, and shod with iron. Instead of a segment, a straight plate of sheet-iron, about $1\frac{1}{2}$ inch broad, may be used, with a space cut out along the middle, through which

the end of a fixed screw on each leg may pass; then by means of two thumb-screws, the legs can be secured at any required distance apart. In many cases where the above may be employed to describe circles, or circular parts, a sort of beam compasses may be substituted. Such may be formed of a piece of inch thick deal board, $2\frac{1}{2}$ inches wide, and 10 feet in length, with a slit along the middle to within about 6 inches of each end, to admit of a screw $\frac{1}{2}$ inch in diameter, passing through and along. There should be two screws, their lower ends being pointed. The length of each screw may be 18 inches, and each should be furnished with two nuts and two washers. Supposing it may be required to have the beam raised about 6 inches above the points, in order to clear any inequalities of surface which it may have to pass over, screw up the nuts, so that the under side of the beam may rest upon them at the above height; then screw down the nuts on the upper side of the beam, but only one of them tightly, until the other screw is moved along the slit, so that the points may be at the required distance apart; and when this is ascertained to be the case, let the other nut be likewise screwed down, in order that a line may be traced without the points being moved from the true distance in the course of the operation. As this instrument can be adjusted so that the points may be securely fixed at any width, within certain limits, and as the beam can be raised more or less, it may be used as a gauge for the breadth of walks, or other distances between two points.

The *Plummet* may be very usefully employed in placing objects correctly upright, such as posts, stakes, and trees. The plummet should be formed with a conical point, and this point should be exactly in the line of suspension, so that when the cord suspending the plummet is held in line with a row of stakes, for instance, the point will touch or indicate the spot where another stake should be driven. The common straight-edge and plummet used by builders will seldom be required by gardeners, for whom a plummet and line will generally be sufficient. With such it is easy to determine whether a tree or other object is placed upright or not, for this can readily be done by suspending the plummet at nearly arm's length, and observing whether the object coincides with the plummet line. If it do, then the object is perpendicular as

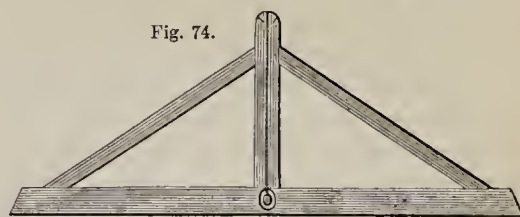
regards that point of view. By moving so as to view the object from a different point, if in a direction at right angles to the former, so much the better, and again observing the object with reference to the perpendicular line, it will be seen whether it is upright, and if not so, in what direction, and how far, it will be requisite to move it. In planting trees with stems more or less crooked, they should be placed so that equal portions may be seen on each side of the plummet line.

Levels.—Wherever walks, roads, or drains are to be made, or indeed whenever grounds are to be laid out, a level is indispensable. Though the surface of the ground may, to all appearance, be quite level, yet it will often be found, when the level is used, to slope considerably. We know of a case where a person, deceived by an apparently level surface, made a drain of considerable length and dimensions, affording, as he thought, a sufficient fall for the water. No level was used. The drain, of brick-work, was completed and covered in; but in a short time it was found that it would not act: it was not level—in fact, the fall was in the wrong direction, and the water, of course, would not run up hill. The consequence was, that the drain had to be taken up, its bottom sloped in the right direction, and the whole work to be done over again. This, of course, was at a great additional expense, which might have been saved had a level been employed. Again, in gardens—not in those made 100 years ago only—it is by no means unusual to see walks intended to be level, or to be of a uniform slope, high in one part of their length and low in another. This not only looks bad, but in wet weather the water collects in the hollows, and frequently renders such walks unfit for being walked upon. Where walks run near the bases of walls, or other buildings, where there are long horizontal lines, nothing can look more unsightly than an uneven walk; for all its irregularities are made more apparent by the horizontal lines of the building. Walks so situated should never be made without the aid of a level.

There are many different kinds of levels. The common level (Fig. 74), used by bricklayers and carpenters, is well known; it merely consists of a straight bar of wood, with another bar placed at right angles to it, and from the centre of which is suspended a plumb-bob and line. The level seen in Fig. 75 is used not only for forming a horizontal surface, but also

for ascertaining whether an object is truly perpendicular or not. The *artillery foot-level*

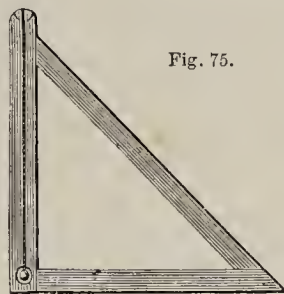
Fig. 74.



Level.

(Fig. 76) has a line and plummet, and a scale of 90° between the two legs. When the plummet hangs in the middle of the scale,

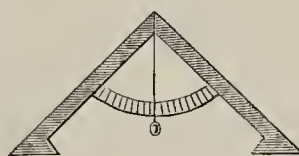
Fig. 75.



Level.

the feet rest on a level surface, otherwise, one foot must be raised, and the degree of acclivity or of descent will be shown on the scale by the line. The

Fig. 76.



Foot Level.

above kinds of level are very useful in the garden whenever any building operations are carried on, or in laying down paving, &c.; and even for ground work, when it is of small extent, or when it is to be left to the execution of those who cannot use the spirit-level. But wherever long horizontal, or uniformly sloping lines, are to be formed, the spirit-level is by far the best and most expeditious. The spirit-level, in its most simple form, merely consists of a glass tube filled with spirits of wine, except a small space which is occupied with air. The bubble of air being lighter than the spirit rises to the highest part of the tube, and when the latter is in a horizontal position, the bubble of air will be in the middle, if the tube is a true cylinder. These tubes, not mounted in any way, may be had for one shilling each. The usual form of mounting in brass, or in wood faced with brass, except over the tube, is well known. They are now frequently bedded in a straight-edge board, several feet in length, and are thus used by builders and others, instead of the more cumbersome plumb-level. A straight-edge board, say 5 or 6 feet in length, 4 inches broad, and 1½ inch thick, with a spirit-tube bedded in the upper edge, will be found very useful in gardens. For example, in making

walks, and having one edging level, the other side can be readily brought to a corresponding level by levelling across.

For taking extensive and important levels to a high degree of accuracy, the theodolite, or other expensive instruments, combining in their construction the action of the spirit-level, are required. An instrument of the following construction will, however, answer all ordinary purposes, and may be constructed at a small expense.

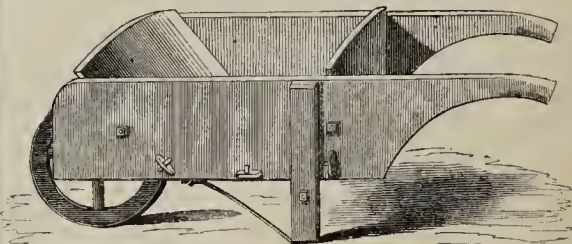
For this a tripod stand is necessary; it may be formed of a piece of hard wood, 2 inches thick; on the face of this describe a circle 8 inches in diameter, cut away the wood on the outside of the circle, except as much as will form three projections, each 1 inch broad, and $1\frac{1}{2}$ inch long; and three smaller semicircular ones in the intervals of the larger. The legs should be cleft or sawed to about half-way down, where they should be well secured from further division by a ferrule. Each of the clefts is then fitted to grasp one of the larger projections, and pins are passed through and screwed, to connect the legs with the top; but so that the former may be easily moved. A cup-shaped cavity should be formed in the centre of the under side of the top, to fit which a ball should be screwed upon the end of a rod; this rod will form a vertical axis, and must pass through a hole in the top sufficiently large to allow it to play a little from side to side. The screw-thread should be continued nearly to a shoulder, formed about 2 inches above the surface of the top of the stand. Against this shoulder, a circular board, $\frac{3}{4}$ inch thick, plated with iron or brass, should be screwed up tightly with a nut. The top of the axis above this shoulder should be conical, and care should be taken that it be perpendicular to the plane of the board last-mentioned. Three screws should pass through the circular projections intermediate with those to which the legs are attached; and their conical points should act against the under side of the circle, so that by screwing up one, and at the same time slackening another, the circle-board can be put in a horizontal position, and, consequently, the axis will be perpendicular. Another circle should be made of the same diameter as the preceding; and in its centre a hollow cone should fit the conical top of the axis, so that the upper circle may be turned round horizontally, and a tube fixed upon it can be directed to any particular point. This

tube may be about 18 inches long, and about the thickness of a gun-barrel. One end should have small cross wires; the other should be closed with a piece of black metal, with a very small hole in the centre to form a sight. A horizontal axis should be made perfectly cylindrical at the ends, but formed in the middle like a hoop, within which the tube, at about half way from each end, should be secured. By means of two uprights fixed on the upper board, at equal distances from its centre, with their tops formed for the ends of the axis to turn in, the tube may be directed higher or lower. The spirit-tube being attached, will indicate the level; and that the sight-tube with the cross wires may be nicely adjusted, so as to bring the bubble in the middle of the spirit-tube, two screws should be attached to the former, the end of one resting on the plane of the circle near one edge, and that of the other near the opposite edge. By turning these screws, the tube may be raised or depressed at pleasure. The upper circle bearing the tube, and turning on the upper end of the vertical axis, should be clamped to the fixed board under it, when the instrument is about to be removed. A level of the above description may be made by any one possessed of a little ingenuity, at a very trifling cost; and it will be found to answer perfectly well for all garden purposes, when the great nicety of the more expensive instruments used by surveyors is not required.

IV.—MACHINES.

Barrows are amongst the first requisites in every garden. The common garden barrow is too well known to need description. A barrow of a different shape (Fig. 77) is used

Fig. 77.



Wheel-barrow.

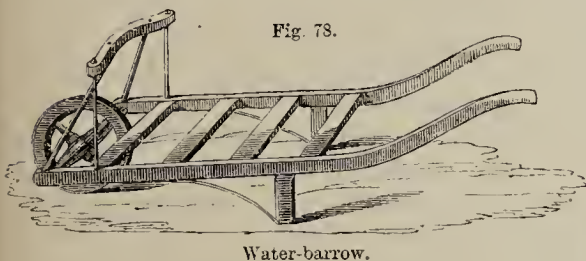
in the market gardens about London. The sides and handles are each formed of one piece of board, generally elm, $4\frac{1}{2}$ feet in length, and 1 foot broad, except where it is cut away on

the under side to form a handle, and a little rounded off the upper corner in front. The sides are about 17 inches apart at bottom, and 21 inches at top; the ends 14 inches apart at bottom, and 27 at top, where the edges of the sides intersect. The back and front ends project 2 or 3 inches above the sides, into which they are mortised. The front projects forward 10 inches from the square, and the end next the handles 3 inches backwards. A barrow of this construction has rather a primitive appearance; but the wheel being near the handles, it can be turned in small compass. This, and its narrow form, adapt it for being used between the rows of gooseberries, currants, &c., where also its contents may easily be emptied over the sloping front.

The navigator's barrow is best adapted for excavating, or other work where planks are required. The wheel is narrow, and made entirely of cast-iron. This being the case, little soil adheres to it. In wet weather, and with clayey soil, wheeling on planks with a broad wheel would be almost impracticable; but the narrow wheel of the navigator's barrow, whilst it has less surface for adhesive substances to stick to, readily cuts its way through them to the plank. From its wide shallow form, it can be much more easily loaded and emptied than barrows with deeper and more upright sides.

The *Water-barrow* (Fig. 78) has handles which are continuations of the two sides;

Fig. 78.



Water-barrow.

their extreme length is 5 feet 3 inches; they are 5 feet from the holes through which the axle passes to their other extremity. The breadth from outside to outside is 20 inches at the wheel, and 24 inches at the handle. The wheel is 18 inches in diameter, and the legs are of such a length as to admit of the barrow standing level. The sides are connected by four cross-bars, the edge next the wheel of the first being 11 inches from the centre of the axle, and the edge of the fourth, or that next the handles, 37 inches from the same centre. A shouldered upright rod

from each side supports the head bar, part of which forms a segment of a circle to fit the side of the cask; and two round wooden stays extend each from near the middle of the head to the sides, into the upper side of which they are inserted. These may be iron instead of wood. The first and third bars, reckoning from the iron uprights, are level with the sides, and are plated with iron, as is likewise the intermediate upper part of each side. The second and fourth bars are not plated, and are a little below the level of the others. The handles curve upwards from the fourth bar to the extent of $3\frac{1}{2}$ inches from that bar. The legs are attached at between 30 and 33 inches from the axle; they are shod with iron, extended to form stays attached to the under part of each side.

The length of this barrow is greater than may seem necessary, seeing that the base of a tub or barrel that will hold as much as a man can wheel, does not occupy much of that length. It can, however, be proved that a barrow for wheeling water should be long; supposing that the tub is quite filled, and in moving it, as it rests level on the barrow, the handles be lifted up say 8 inches, the tub will then be on an inclined plane of 8 inches in 5 feet, and a certain quantity of the water would, consequently, run over. But if the tub were to be wheeled on a barrow with the handles only $2\frac{1}{2}$ feet from the axle, and let these be raised only to the same height, 8 inches, as before, yet the inclination would be doubled, and so likewise the overflow of water. The level of the water in the tub is affected by every inequality of surface over which the wheel passes; but it is less disturbed when the handles are long than when they are short. To prevent the water from being jerked over in wheeling, a wicker float is frequently employed, and it is found to answer better than a piece of board. When not employed in wheeling tubs of water, a barrow of this kind may be used for vegetables, litter, baskets, or anything that will not fall through the spaces between the cross-bars of the bottom.

Fig. 79 represents a long barrow employed in the market gardens near London, for wheeling vegetables from the grounds to the packing-yard; also baskets with fruit, for which it is well adapted. for twelve or more of those termed half-sieves, can be conveyed on one of this description.

Hand-barrows.—A simple form may con-

sist of two bearers, with a flat boarding; but for many garden purposes, one of the following description will be found very suitable. The length of its sides, tapered at the ends to

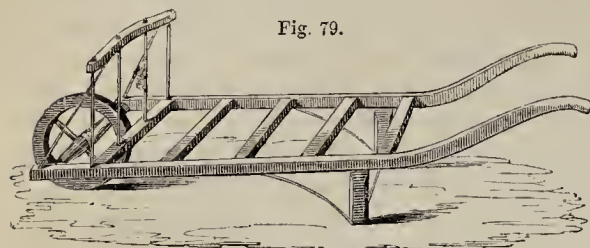


Fig. 79.

Market-garden Barrow.

form handles, is 7 feet 4 inches, the length of the box part is 39 inches, the depth 2 inches, the width at bottom 23 inches, at top 24 inches, the sides are thinned a little towards the upper edge on the inside; where this is not the case, their thickness is $1\frac{1}{2}$ inch; their whole breadth is 5 inches. The bottom boards extend lengthwise, and are left a little apart, to admit of water passing through; they are $\frac{3}{4}$ -inch thick, and are supported on three bars mortised into the sides. The legs, extending from the upper edge of the sides, are 15 inches in length; they are bolted to the sides by an iron rod, passing from side to side, immediately under the bottom, and higher up each is secured to the end board by a nutted screw, which is flattened after passing through the leg and side, so as to form a strap, which, extending about 6 inches along the end inside, is secured to that part. The corners may also be clamped or strapped with iron. This hand-barrow is well adapted for carrying heavy pots with plants.

Hand-barrow for Carrying Fruit.—Very choice fruits of apples and pears should not be heaped above each other in taking them from the trees to the fruit-room. It is therefore desirable to have a barrow that will hold a considerable quantity in a single layer. One of the following construction (Fig. 80) has

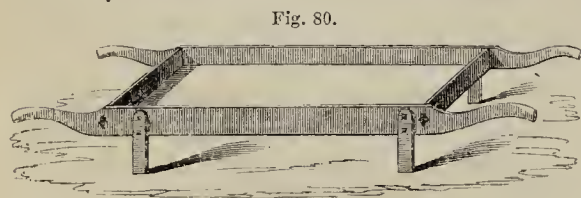


Fig. 80.

Fruit Hand-barrow.

been found very suitable for the purpose. The box part is 4 feet 7 inches long, by 2 feet 2 inches, inside measure, or outside, the length

of this part is equal to twice the width; the bottom for the fruit has, therefore, an area of 10 square feet. The depth is 4 inches; the length, from one extremity of the handles to the other, is $7\frac{1}{2}$ feet. The handles are continuations of the same piece of wood which forms the respective sides. The bottoms, supported by two bars of wood, dove-tailed and screwed into the under edge of the sides, which extend the thickness of these bars, or about $1\frac{1}{4}$ inch below the bottom. These bars are 17 inches apart. There is also at each end an iron rod, which passes close under the bottom for its support, through the sides and legs, which it lightly connects at that part. Higher up, the sides are screwed to the ends; the screw passes through the side to catch the nut; but its other end is flattened into a strap, which is secured by screws to the end. The legs, from the top of the sides to the ground, are about 15 inches long. The bottom of such a barrow, when fruit is to be carried in it, should be lined with straw and a mat; two or more layers of the less choice sorts of fruit may be carried safely enough, provided a double mat be interposed between each.

Fumigators are used for fumigating plants infested by green-fly and other aphides. If in houses or pits, these should be shut up. If a single plant in a house or one growing out of doors, is to be freed from insects by fumigation, it should be covered with a cloth, well wetted to prevent the escape of the smoke. The tobacco having been ignited, the mouth of the apparatus is introduced through an opening in the cloth for the purpose. After allowing the house to be shut up for the night, the plants should be well syringed next morning, in order to cleanse the leaves of the acrid substance deposited by the condensation of the smoke, and to remove such of the insects as have only been stupified. If the plants have not been completely freed of the insects by the operation, it must be repeated.

There are several kinds of fumigators, some of which may also be used for dusting plants with lime or snuff.

Read's Fumigator consists of a pair of bellows and a cylindrical canister, in the interior of which is a perforated plunger to keep down the tobacco. The smoke of this, when ignited, is driven by the bellows through a pipe, by means of which it may be directed against the plant to be fumigated.

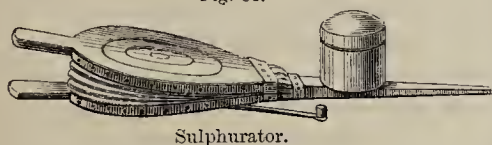
A very portable fumigator consists of a

copper cylinder, with a grating at each end. Within this the tobacco is placed and ignited, a long tube proceeds from one end of this cylinder, and the other is attached to the nozzle of a pair of bellows like that of a common one, but longer, in order that the heat may not injure the leather.

A common mode of fumigating is to make a hole in the side of a flower pot, near the bottom, so that the nozzle of a pair of bellows can be introduced. A little live coal is put into the bottom of the pot, then the tobacco, and over this some damp moss. By this arrangement, and gently blowing, slow combustion is produced, which is essential for the destruction of insects; for if tobacco is burned rapidly by too free access of air, the narcotic principle is in a great measure destroyed.

Sulphurator.—Since the attacks of mildew on the vine and other plants have become so prevalent, and as flowers of sulphur is the best known remedy, sulphurators have become very necessary. Accordingly, various kinds have been invented, some working with a wheel, on the principle of a fan, others like the bellows. Fig. 81 represents one which answers exceed-

Fig. 81.



Sulphurator.

ingly well. The boards forming the sides of the bellows are 7 inches in diameter, forming two-thirds of a circle round the flap opening, then tapering to the place where the nozzle is fixed on the wood. The upper board is cut across, the leather covering over the cut, forming the hinge for allowing the board to move up and down. On the upper side of the tube is a circular tin box, 3 inches in diameter, and $2\frac{1}{2}$ inches deep, for holding sulphur, which, on being introduced, and the lid fitted on, passes through holes in the bottom of the box and upper side of the tube, from the interior of which it is expelled by the action of the bellows. On the under side will be observed a thin spring strap, bearing at its further extremity a piece of iron which strikes against the tin tube as the bellows is worked, and shakes the sulphur into the tube when it would otherwise not pass through the holes. The boards are made of thin hard wood about $\frac{1}{16}$ -inch thick. The leather is also very thin and exceedingly pliable, and to this must be

ascribed the superiority in extent of blast, which this small apparatus possesses over those of larger dimensions, but with thicker leather. The above is a cheap, convenient, and easily worked apparatus. It also economizes the sulphur, by finely distributing the particles; and, on the whole, is greatly to be preferred to those machines which throw out the sulphur in irregular volumes, and which cannot be controlled to give a well-distributed slight dose when such is required. The wheel machines are not so manageable for garden purposes, for which reason they need not be further noticed.

Mowing Machines.—These can only be advantageously used in dry weather, and on lawns that are level. Where there are large trees the ground is naturally elevated round their stems, and a scythe is found better adapted in cases where such inequalities occur. Mowing machines cannot be well used in wet weather, the cutters being then apt to clog, and in such weather grass requires more frequent mowing. By persons not accustomed to using the scythe, it is deemed very trying work; in this case, a mowing machine may be preferred. Some of large size, and drawn by a horse, are employed for extensive lawns such as those of the Royal Gardens at Kew.

Syringes are essentially necessary in most gardens; they are indispensable where there are glass structures for plants and forcing; and in small gardens they may be substituted to some extent for the garden engine, as regards fruit-trees.

There are now many kinds of syringes, generally of good construction. The simple form was a straight tube with a piston, by which, however, the water could only be drawn up through the rose on the end, and consequently when the perforations were fine, the cylinder could not be speedily filled. This, though cheaper than the improved ones in the first instance, is not so economical in the long run, owing to the loss of time in charging.

Read's Patent Syringe, Fig. 82, is a great

Fig. 82.



A B
Read's Syringe.

improvement; for, however fine may be the rose used, the water can be readily drawn up. This is owing to the water being chiefly ad-

mitted through a nozzle, in the neck of which a ball valve is caged. When the piston is drawn up, the ball is raised sufficiently to admit plenty of water; and when the piston is pressed down, the ball is driven forward and closes the nozzle, so that the water can only pass out through the perforations of the rose. In short, the water is chiefly drawn in through the nozzle by an opening about $\frac{1}{16}$ -inch diameter, and is expelled by as many as thirty openings, each of which, in a rather finely perforated rose, would only admit a small pin. By steadily drawing up the piston it will be closely followed by the water, from the latter having free ingress, and on this account, more water can be thrown out in the same time, than in the case of the simple form, in which the ingress is limited. Read's syringe has another good principle, which tends greatly to easy working, and the prevention of the escape of water. In the centre of the top which screws on the cylinder, there is a stuffing-box through which the piston-rod works, but with this arrangement, air could not escape when the piston-rod is drawn up; nevertheless, it being necessary that it should do so, there is a hole near the top, and in some of the newest instruments, a small tube attached and turned downwards, by means of which, a free communication for the egress of air when the piston is drawn up, and for ingress when it is pushed down, is maintained. The syringe is furnished with roses of different degrees of fineness, as seen in Fig. 82, A and B, or with a single tube when it is requisite to force out the water in one unbroken stream. By means of an angle branch, which may be attached to the syringe, the stream of water may be delivered in any direction, so that the under sides of leaves, &c., may be washed. In using syringes, great care should be taken not to indent their sides by dashing them against the edge of the watering-pot, or by placing them where they are apt to roll off and fall upon a hard substance. It should be remembered, that a single indentation renders the cylinder no longer a true one, and then the piston cannot fit accurately. To prevent injuries so apt to occur to the cylinder, unless great care be taken, syringes have been made with an outside cylinder, leaving a small cavity between it and the inner one; if this outside case should be accidentally indented, it is immaterial to the working of the apparatus, so long as the inner one remains unaffected. There are va-

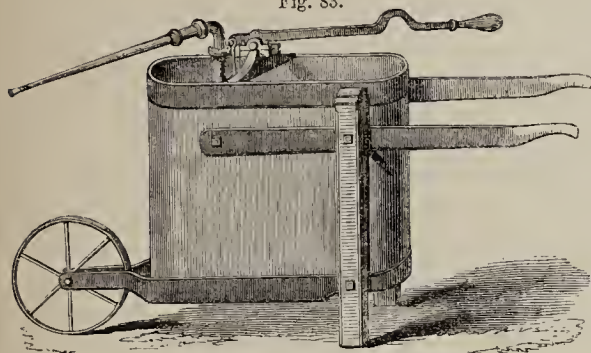
rious other kinds of syringes, but we consider Read's to be the best, and the cheapest in the long run.

Watering Engines.—Of these there are several kinds used in gardens, some being hand-engines, and others barrow-engines. They are now made to act on the principle of the force-pump, that is, a cylinder or pump barrel is fitted with a piston; on this being drawn up a vacuum is produced, and the water in which the lower end of the cylinder is immersed, is pressed upon by the atmosphere and driven up into the cylinder, which is thus filled with water as far as the piston is raised. A valve at the bottom of the pump barrel prevents the water from returning into the tank. A communication with a side vessel is closed by a valve at its base, and the side vessel is closed air-tight round a tube reaching nearly to its bottom. On the piston being pressed down the water forces open the valve of the adjoining vessel, in which it consequently rises by every downward stroke of the piston, and covers the lower end of the tube. When this takes place, the free egress of the air in the top of the vessel is cut off, and it is compressed as the water is forced in from the barrel through the valve below. But the water itself is equally pressed upon by the elasticity of the compressed air, which acts like a spring till it regains its natural space; and so long as this is not attained, the water will be constantly forced up into the tube, and be discharged in a continuous stream, or streams, according as it is allowed to escape at top through a single pipe, or through the perforations of a rose. We have thought it necessary to endeavour to explain the principle of these pneumatic engines, and it may be well to give some idea of the force which may be exerted by means of the above arrangement; for, in ignorance of this, certain parts are often torn to pieces. By means of the leverage afforded by the handle, a man pressing upon the latter with a weight equal to 10 lbs., may communicate to the piston a pressure of 100 lbs. on the inch, and this pressure will be communicated to every square inch of the interior of the pipe, should any obstruction prevent the discharge of the water. On a portion of a pipe, 1 inch in diameter and 12 inches in length, the pressure would therefore amount to 3770 lbs. This shows that the machinist should make the tubes very strong, and that the person who uses the engine should not urge the pis-

ton too much, when he has cause to suspect that some obstruction has taken place.

Hannay and Dietrichsen's garden engine (Fig. 83), has several important advantages

Fig. 83.



Garden Engine.

over some others. It is easily worked, not liable to get out of order, and with one wheel, it is very portable, and can be readily turned in small space. The air-vessel is a hollow cast-iron sphere, through the centre of which the piston barrel is fixed, and also the upright part of the discharge pipe. The piston has a double action. There are three ball valves, by means of which water is admitted in moving the piston either up or down; so that with a short stroke, as much water is pumped in as would otherwise be the case with twice the length of stroke. A cast-iron bridge is surmounted by the fulcrum for the leverage of the handle, and this fulcrum is an axle working in brass collars, the handle being fixed on a square in the middle of the axis. This works very smoothly, and is a great improvement on the former mode of leverage, according to which, the fulcrum was attached at the front of the engine, and the lever to the piston-rod at a point between the fulcrum and the hand, by iron pins; these soon got worn and acquired too much room, making a clacking noise at every movement of the handle up or down. The tank of the engine in question is made of copper, or of galvanized iron; or it may be made of wood, which is better than the galvanized iron. If the latter, or copper, form the cistern, the bottom of it is bolted by screws to inch-and-quarter board below. The cistern is supported by the legs, and by the irons which extend so as to form bearings for the ends of the axle. These irons are about 4 inches broad, half of which is bent at right angles downwards, the other half is fixed to the bottom by two screw-bolts.

V.—UTENSILS.

Pots.—These are generally made of clay, a certain quantity of which is called a cast. This is formed into from one to eighty pots, according to their size. The dimensions of the pots made in London and its vicinity are as follows:—

NAME.	Number to the cast.	Diameter at top.	Depth.
		Inches.	Inches.
Twos, or 18-inch,.....	2	18	14
Fours, or 15-inch,.....	4	15	13
Sixes, or 13-inch,.....	6	13	12
Eights, or 12-inch,....	8	12	11
Twelves, or 11-inch,....	12	11½	10
Sixteens, or 9-inch,.....	16	9½	9
Twenty-fours, or 8-inch,	24	8½	8
Thirty-twos, or 6-inch, .	32	6	6
Forty-eights, or 5-inch,	48	4½	5
Sixties, or 3-inch,.....	60	3½	3½
Eighties, or thumbs,....	80	2½	2½

The dimensions of pots vary, however, considerably, according to the locality and the particular pottery in which the pots are made.

The various sizes of garden pots have one prevailing characteristic in their form, which is that of being wider at top than at bottom. This is necessary on account of shifting the plants grown in them; for if the sides were perpendicular, the ball of earth could not be turned out without breaking the pot. Sandy soil, even without roots growing in it, could not by any means be pressed out of an earthenware cylinder, unless a very short one. Hence, it is evident that pots must be made widest at top. Whilst this is admitted, yet the less they taper, so as shifting can be effected, the better; for the pot will then contain more soil for feeding the roots. It may be said, that the same quantity of soil could be insured by making the pot deeper; but in that case the ball of earth must assume a conical shape, and as it shrinks when dry, it would act like a wedge downwards. Then, when saturated, the ball cannot raise itself up, and must consequently be compressed. When again dry, it shrinks and wedges lower, to be again compressed when saturated. Long tapering pots are therefore not to be recommended. Generally, pots of large size are wider than they are deep; and on the contrary, the depth of small-sized pots equals or exceeds their width.

It has been a question, whether glazed or unglazed pots are best for plants. The glazed

pots have a clean appearance; they do not evaporate so much water as the porous earthenware; and the ball can be more easily turned out in shifting, from the smooth glazed surface than from a rough one. In these respects, the glazed pots have some advantages; but these are more than counter-balanced by the higher price. There is also a greater compression of the ball of soil, and consequently a greater cavity between the sides and ball of earth, than in the case of common pots. The price may not be a matter of great importance with some, although in extensive cultivation it would be a consideration. But the glazed surface is objectionable as regards the growth of the plants. In the common pot there is somewhat less cohesion between the soil and the sides of the pot, than there is between the particles of the soil itself. But if this be the case to some extent with soil in contact with the rough material of the common pot, there will be still less cohesion when the soil is in contact with a glazed surface, affording scarcely any hold for the soil. If a substance could be made, to which the soil would have a degree of adherence equal to that which exists amongst its own particles, common rich garden soil might be used in pots, without becoming a hardened mass, as it almost invariably does when employed in that way. Probably no substance capable of being manufactured possesses so much the property of adhesiveness to the soil, as the common pot; whilst the glazed pot possesses the least; and therefore its use cannot be generally recommended. Where the nature of the plant admits of a very fibrous soil, or peat, glazed pots may be used, for in such soil cohesion of the particles is prevented by the fibre.

Drainage for the roots of plants being essential, it is usually provided for by one hole in the bottom, or by several smaller ones in that part, and in the side near the base. For large plants, however, pots are now made with one hole in the bottom large enough to admit the end of an upright post, and over this is laid a stout moveable bottom without holes. When the plant is to be shifted, the pot is kept upright and placed on the top of the post, and thus the pot is pushed down whilst the ball is not, but remains on the top of the post with the flat circular bottom under it.

Besides the common forms, pots are made with double sides, with raised bottoms, also with projecting bases. The double-sided pot

has a small opening at top by which the space between the two sides can be filled with water, and thus the withdrawal of moisture from the soil by evaporation from the sides of the pot is prevented. But the same object is usually effected by placing one pot within another of a size or two larger, and stuffing the space between them with moss. The pot with a bottom raised like that of a champagne bottle, is the suggestion of Mr. Rendle, of Plymouth, and is considered useful for propagating. The hollow cone serves as a hot-air chamber, imparting a genial warmth to the soil in the pot, and so stimulating the vegetative powers of the cuttings placed in it. Draining materials are introduced between the sides of the pot and the cone, in which there are holes to permit the escape of the water. In some particular cases where pots have to be placed where they are apt to be turned over by wind, a projection may be formed so as to increase the base, and proportionally the stability of the pot. This projection may either be of a tripod form, or continuous like the base of a vase.

Shallow pots and pans, the latter either square or round, of various sizes, are used in propagating.

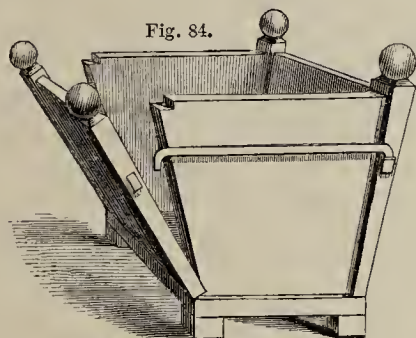
Earthenware Saucers or Flats, are made of different sizes, to suit those of the pots which are placed in them. Glazed saucers for plants in rooms are sometimes made, and are preferable because they do not allow the water to pass through and cause damp on whatever they may be set. Some are also made with a short column projecting from the centre, on the top of which a plant in a pot may be placed; the base of this column being surrounded with water, the plant so situated will be safe from all enemies that cannot travel by water or air. A common saucer, in which is placed an inverted flower-pot, or a saucer of a smaller size, bottom upwards, will answer the same purpose as the contrivance just mentioned, and being cheaper, and, when not required, more easily stowed away, they are generally substituted for it.

The *Blanching Pot* is used for blanching sea-kale, rhubarb, &c.; it is an earthenware pot which is made in various shapes, and has a top which may be removed, so that the fitness of the vegetable for use may be ascertained without lifting the whole pot. Frequently, common garden pots, with the hole in the bottom covered with a piece of slate or

flat tile, are substituted for blanching pots, and answer the purpose very well.

Plant Boxes are used for growing orange-trees and other plants of large size. They should be constructed with moveable sides, so that the roots may be examined and the soil renewed when necessary. Wood is the material usually employed in their construction, but slate is also sometimes used. Slate boxes possess the advantages of great durability, and of being easily kept clean and free from insects, to which they do not afford so many lurking places as the wooden ones. The orange tree boxes used at Versailles are cubical and made of oak; the bottoms are pierced with holes to allow the water to pass away; two of the sides are fixed, the others are moveable; and each of the moveable sides is kept in its place by iron bars, one end of which turns on a bolt, whilst the other lies in a hasp, and may be lifted up when the side is to be taken out. These boxes last for fifteen or twenty years, and in them are growing trees 30 feet in height, and 39 inches in circumference, some of which are upwards of 300 years old.

MacIntosh's plant box (Fig. 84) has a neater



MacIntosh's Plant Box.

appearance than the preceding; and all its sides being moveable, it offers greater facilities for removing the trees, examining their roots, replacing old soil with fresh, &c. Two of the sides being hinged to the bottom, may be opened down by lifting up the iron bars; the others, which are not hinged but lift up, may then be easily removed.

Wooden Tubs are used for the same purposes as plant boxes, the latter, however, when they have moveable sides are preferable; for the roots of plants grown in tubs can neither be examined, nor the soil renewed, without knocking off the hoops and removing the staves, to replace which the aid of the cooper becomes necessary.

Sieves and Screens are useful in gardens for

sifting earth and for screening gravel mould, &c. Sieves with very small meshes are also used for cleaning seeds.

Lime Duster.—It is often necessary to scatter newly slaked lime on trees, &c., for the destruction of insects; and as lime in this state is too caustic to be applied directly with the hand, a lime duster is occasionally employed. It is made of tinned iron. Its general form is that of a bottle with a wide neck. The length, exclusive of the handle, is about a foot, and it is about 7 inches in diameter at bottom, which is somewhat convex, and pierced with holes to permit the particles of lime to pass out by shaking. The handle is about 2 inches in diameter and 5 or 6 inches in length, with a cap which is fitted on after the lime has been introduced; or instead of the cap being put on, the end of a long wooden handle may be inserted for the purpose of dusting high trees.

Grindstone.—The utility of a grindstone is such, that it is said to be an accompaniment of civilization into the most remote parts of the world. It is almost indispensable in a garden, for when cutting tools are not kept properly sharpened, they can only be used with great disadvantage. In many cases, only half the amount of work can be performed with a blunt tool that can be done more perfectly with a sharp one in the same time, and with less exertion. It would be well to have a large stone for spades, hoes, &c., and a smaller one of closer grit for fine-edged tools.

Watering-pots are generally made of tinned iron, sometimes of zinc, or of copper. When made of copper, they possess the advantage of great durability, but are more expensive in the first instance, and heavier than those made of tinned iron; besides which they are liable, under certain circumstances, to communicate poisonous qualities to the water. Zinc is cheap, but not durable. On the whole, stout tinned iron, kept well painted, is most to be recommended. For general use in gardens, they are usually painted red, red lead being more durable on metal than perhaps any other paint. Watering-pots are sometimes painted green, or other colours; but the inside should nevertheless be painted red, as well as the outside of the bottom, and its surrounding ledge. When watering-pots require to be fresh painted, the old paint can be entirely removed, and the tinning renewed if it then be seen anywhere corroded; when well washed

and thoroughly dried in a temperature above 212° , a fresh coat of paint should be applied.

According to the sort of plants to be watered, roses pierced with holes of greater or less size are employed. For plants growing out of doors, the common watering-pot with roses, also of tinned iron, pierced with comparatively large holes, is used. For tender plants, watering-pots of smaller size, with very fine holes, are necessary. These roses should be made of brass or copper, and to screw on and off, so that roses of two or three different degrees of fineness may be used with the same watering-pot. A pot with a long spout, which is bent where the rose is fixed, at right angles, or nearly so, is used for watering plants in pits, or on shelves, at a distance from the operator; this spout may either be fixed or moveable; and fitting it, there should be two or three roses pierced with holes of different degrees of fineness.

Money's Inverted Rose Watering-pot has a fixed spout, with which is employed a rose delivering the water upwards, so as to let it fall in a gentle shower; there is, in addition, a tube which may be screwed on to the spout, and used with a smaller rose that delivers the water downwards, exactly over the object to be watered. Watering-pots of the above description are well adapted for the use of amateurs, and for watering seedlings and delicate plants.

There are several kinds of watering-pots, in which the escape of the water can be prevented at pleasure by the shutting of a valve by means of a spring or some other contrivance; these are generally, however, of too complicated a nature for common use.

The common form of the watering-pot with a straight rose, for open ground work, and smaller pots with straight tubes of different lengths, but adapted for having roses either straight or bent-necked fixed upon them, will answer every purpose required of these utensils. By the straight-necked rose, the water can be directed forward; and upwards, downwards, or more or less to either side, by the rose with a bent neck capable of turning round.

It is too frequently the case, that the brass screws by which the fine roses are fixed, have the threads too small and shallow, and are, consequently, liable to be overhauled. The maker should recollect that the screws have to be worked by rougher hands than those accustomed to the use of delicate apparatus.

Ladders.—Various kinds of these are re-

quired in gardens and orchards. For wall-trees, a *Step-ladder*, with boards for steps, is far preferable to one with rounds. The sides and steps should be made of clean well-seasoned deal, and at the top two iron spurs should be attached to the sides, for the steps to rest on when they are placed against the wall, that the trees may not be injured. The spurs, as well as the steps, should be fixed at an angle of about 85° with the sides, so that when the ladder is inclined against the wall, the steps and spurs may be horizontal. For pruning standard trees, and for gathering fruit from such, the ladder should have the sides from 2 to $2\frac{1}{2}$ feet apart at the bottom, in order that it may have a good footing sideways, for this is more necessary in ladders, the tops of which have to be placed against the bending branches of trees, than in those that are placed against solid walls. An iron round near the lower end, another in the middle, and one near the top, are very useful for keeping the sides from shifting out or in; the iron rounds should be shouldered against the inner part of the sides, and secured with a screw-nut on the outside. The iron round at top is sometimes made to project on each side, in order to receive the eyed ends of poles, which may be thereto attached, and secured with a pin, to form support independent of the tree. But these projections cause obstructions when the top of the ladder has to be pushed up amongst the branches. It is, therefore, better to dispense with the projecting ends, and have the poles forked at top to catch the iron round. Two forked poles are generally used in Herefordshire as supports to a fruit-gathering ladder. They are readily placed, and more easily carried from place to place when they are separate from the ladder, than if attached to it. *Folding Steps* are occasionally useful in gardens and hot-houses. Two pairs of them, with a plank between, may be used as a stage in summer-dressing wall-trees. *Jointed Ladders* are required for curvilinear roofs. A piece of board is fixed across the top, to rest upon the bars, and another lower down, if necessary. Ladders have been made for orchard work with two strong supports, connected by iron stays from one support to the other, and from the supports to each side of the ladder; it is thus rendered self-supporting. On the upper sides of this ladder irons are fixed and curved, so as to admit of a second ladder being pushed up be-

tween them and the rounds of the one below. The second ladder is secured by a stout iron strap, resembling an **S** in shape, in one end of which a round of the upper ladder is placed, and the other end of the strap is hooked upon the round next above of the fixed ladder. This contrivance may be usefully employed in some cases; for example, it may be placed near a tree, and without leaning against any of the branches, the upper ladder can be pushed up into the centre of the tree. It is, however, not so easily moved as a common ladder.

Baskets.—Several kinds of these are required for carrying vegetables and fruit, and for various other purposes. They are generally made of willows, and in the finer kinds the willows are peeled. The bark, however, tends to rot the wood, and to occasion mouldiness; so that, in most cases, it would be economical to take it off, even though it occasions more labour in the first instance.

Baskets used in England for carrying vegetables are generally those well-known white or peeled willow-baskets, sometimes called cross-handled baskets. In Scotland, baskets for the above purpose, have the rim, handle, and ribs, made of ash, hazel, or other flexible wood, and these are worked with peeled or unpeeled willows. They are contracted in the middle, and this allows the weight to come nearer the centre of support, so that a load can be more easily carried than in those of an oval form, in which the weight is thrown farther from the arm and side of the bearer, and, consequently, has a greater leverage.

The gathering basket is about $12\frac{1}{2}$ inches in diameter at top, $8\frac{1}{2}$ at bottom, and 11 inches deep, inside measure; and it contains about one-third of a heaped bushel. It has a cross-handle, to which a hooked stick is attached by a cord; this serves to hook the basket on a branch, or on a round of the ladder, when gathering orchard fruit; and when employed for the purpose, the basket should be lined with some soft material to prevent the fruit from bruising. On this account a shallow basket would be preferable; but the one described is more convenient for passing between the branches.

Baskets in use for fruit and vegetables for the London markets are of various kinds. That called a *half-sieve*, is a cylindrical basket, from 12 to $12\frac{1}{2}$ inches in diameter, and 6 inches deep. A rim tapering inwards is sometimes added to the top of this sieve, and

over this willow caps are fixed, in some cases. The whole resembles a cylinder surmounted by a cone. The half-sieve, when heaped, contains about $3\frac{1}{2}$ imperial gallons.

A willow basket, called a *barge*, is used for packing half-sieves in. Its bottom and top are of the same size, the sides are parallel, the ends rounded to fit the curve of the half-sieve basket; its dimensions admit of two of these being placed in the bottom, two above these, and two with caps make a third tier, or in all six half-sieves. The two upper ones are lashed down by a cord passing through handles at the sides and ends of the barge. The packing of the fruit in the half-sieves in the first instance, and again these in the barge, occasions much labour, and on this account, baskets called *sieves*, are made to hold as much as two of the half-sieves; others contain a bushel; these not being heaped are placed above each other in a spring van or waggon.

Bushel baskets are also made like the inverted frustum of a cone, and about $14\frac{1}{2}$ inches in diameter at top, 10 inches at bottom, and 17 inches deep.

Large round baskets, for the carriage of choice fruit, are made of peeled willows, and are somewhat wider at top than at bottom. In order to keep the layers of fruit from pressing upon each other, a ledge is worked with willows about half-way up; when a layer of fruit is packed in the bottom, a flat willow basket-worked partition is placed over it, and this resting on the ledge, admits of another layer of fruit being placed upon it, without pressing upon the fruit below. The lid for covering the top of the basket in question should be convex, and fitted with an oil-cloth cover, in order that wet may be thrown off.

Deep oval baskets or hampers, more coarsely made than the preceding, are frequently used for the carriage of vegetables. The lids should be convex, for in this form they have greater strength than when flat; besides they admit of the substances being heaped likewise in a convex form above the edge of the hamper, so that when thatched over with some broad kind of leaves, or with grass, the rain will descend towards the outside, instead of lodging among the contents of the basket.

Hampers of smaller size are used for packing small plants in pots, and occasionally parcels of fruit. For the latter purpose, the ends of the willows should be carefully trimmed off, otherwise they would injure the fruit; nor

should the form of the hamper be long and narrow; for when this is the case, after the sides are lined, there is comparatively little space for holding fruit. The less difference there is between the length, breadth, and depth of any box or basket, the greater will be its contents, in proportion to the area of its surface. Accordingly, it will be found that a hamper, say 36 inches long, 10 inches wide, and 6 inches deep, will have 1272 square inches of surface. Another, 17 inches long, 15 inches wide, and 11 inches deep, will have a surface of 1214 square inches, or somewhat less than the preceding. Although the longer hamper would require more willows to make it, from its greater surface, yet its capacity is only 2160 cubic inches, scarcely a bushel; whilst that of the other, approaching more nearly to a cube in form, contains 2805 cubic inches, or more than $1\frac{1}{4}$ bushel. This may be usefully borne in mind where capacity is the chief consideration, and where the substances to be packed may be placed above each other without injury. Fruit hampers, 20 inches long, 12 wide, and 8 deep, are found to be a very convenient form.

Punnets are round shallow baskets, made of deal, split very thin. They are much used about London for holding strawberries, plums, peaches, or other fruits, also salading. The deal is first split like laths, the pieces are then steeped in water to give toughness and pliability, when they are again split for working. In doing this, the knife must be entered not in the direction of the annual layers, but at right angles to these, or in the direction of the medullary rays or silver grain, otherwise the wood will not split well. Some thin splints taken off in this way, and about an inch broad, are cut in lengths equal to the intended width of the punnet, and twice its depth. These are laid across each other, so that their extremities may radiate at equal distances. Thinner, narrower, and very pliable strips are then woven in, till a circle, the width of the bottom, is formed. The straight pieces are then bent upwards to form the sides; in some these are quite upright, in others they spread outwards or inwards, when the bottom of one punnet is intended to rest on the top of another. The size, form, and relative dimensions vary according to the purposes for which they are employed. They should always be lined with leaves, paper, or other substances that will prevent the sharp

edges of the wood from injuring the fruit, which they are apt to do, if it is packed without due precaution being taken. Although so very common about London, this basket has been thus noticed, because it is not known in many parts of the country.

Pottles.—These are occasionally made to hold the measure of a pottle, hence their name. Generally, however, they are much smaller, and are chiefly used for holding strawberries and raspberries; but they are certainly not well adapted for the purpose, and are now less employed than formerly. They are made of thin split deal, and of a long tapering form, narrow at bottom, and furnished with a handle over the mouth. Being widest at top, they cannot stand without support, but may be packed in a head-load basket to the number of thirty-six; and in this way, chiefly, strawberries were taken to the London market previously to the general use of spring-vans for that purpose.

VI.—METEOROLOGICAL INSTRUMENTS.

The Thermometer.—The value of this instrument in the garden is so great, and so universally acknowledged, that it is unnecessary to descant upon it. As there are several sorts of thermometers, differing in their construction, and adapted for particular purposes, a description of such of them as are necessary or useful in a garden may, without impropriety, be given.

The thermometer is constructed on the principle that all bodies expand under the influence of heat, and contract by cold. To this general law, water below 40° is, however, an exception. Any body might be employed for the purpose of measuring the intensity of heat; but the expansion of solids is too small, whilst that of gases is too great for ordinary purposes—liquids, the expansion of which is greater than that of solids, and less than that of gases, must therefore be employed. Mercury is the one most used, and which is best adapted for this purpose; for its expansion is more uniform, and the difference between its freezing and boiling points is greater than in other liquids. The common thermometer consists of a tube of very small bore, which should be of equal diameter throughout, and on one end of which a bulb is formed. Into this mercury is introduced, by rarefying the air in the inside of the ball, and then dipping the open end of

the tube into mercury recently boiled, in order to expel air and moisture. As the air in the bulb and tube cools and contracts, the mercury is forced up into the bulb by the pressure of the atmosphere. When the bulb and tube have been filled with a sufficient quantity of mercury, this is boiled once, or oftener, if a very accurate instrument is to be made. The open extremity of the tube is then hermetically sealed, the mercury being driven up the tube by heating the bulb, in order completely to expel the air. A scale has then to be graduated. To do this, two points must be obtained, namely, the freezing and boiling points of water; the height at which the mercury in the tube stands at these temperatures being marked, the intermediate space is divided into degrees, the number of which unfortunately varies in different countries. In Britain and North America, Fahrenheit's scale is used; in France, and nearly all over the Continent, the Centigrade is employed; whilst in some countries Reaumur's scale is still used.

The freezing point of water on Fahrenheit's scale is placed at 32° ; and the interval between this and the boiling point is divided into 180° . On the Centigrade scale, and that of Reaumur, the freezing point, or 32° Fah., is 0° ; and the interval between the freezing and boiling points is divided into 100° on the Centigrade, and 80° on that of Reaumur. Knowing the relation that exists between the degrees of the different scales, a temperature expressed in degrees of one scale may be easily reduced to the corresponding temperature of another; but as the necessary calculations are very troublesome when they have frequently to be made, it is better to procure comparative tables, by the use of which the result may be obtained by inspection.

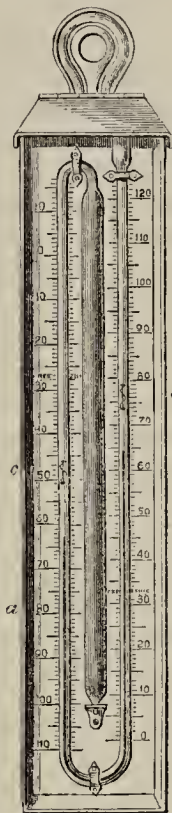
The largeness of the divisions on Reaumur's and the Centigrade scales, render the use of fractional parts of a degree frequently necessary; but another and greater objection is, that whenever the thermometer stands below freezing, the use of — degrees also becomes necessary, and this in every series of observations is very inconvenient.

Self-registering thermometers are so contrived as to mark the extremes of temperature; and on this account they are valuable for meteorological purposes, and likewise for placing in hot-houses. Several kinds of self-registering thermometers have been invented; but those of Six and Rutherford are the ones

generally used. Of the former of these instruments, the following excellent account has been given by Professor Traill:—

Six's Register Thermometer (Fig. 85) is a spirit-of-wine thermometer, with a long cylindrical bulb, and a tube bent

Fig. 85.



Six's Self-Registering Thermometer.

in the form of a siphon, with parallel legs, and terminating in a small cavity. A portion of the two legs of the siphon, from *a* to *b*, is filled with mercury; the bulb and the remainder of both legs of the siphon, as well as a small portion of the cavity, are filled with highly rectified alcohol. The double column of mercury is intended to give motion to the two indices *c*, *d*. Each index consists of a bit of iron wire inclosed in a glass tube, which is capped at each extremity by a button of enamel. Their dimensions are such, that they would move freely in the tube, were it not for a thread of glass drawn from the upper cap of each, and inclined so as to press against one side of the tube, forming a delicate spring of sufficient power to retain the attached index at any part of the tube to which it is raised by the column of mercury. The action of the instrument will now, we believe, be readily understood. When an increase of temperature expands the spirit in the bulb, it depresses the mercury in the limb *a*, and proportionally raises it in the limb *b* of the siphon; the mercurial column in the latter raises the index *d* before it; and when the mercury sinks in that leg, the bottom of the index *d*, retained at that height by the glass spring, will indicate how high the mercury had risen. When the spirit in the bulb contracts by cold the mercury in the limb *b* descends, and the consequence is a proportional ascent of the column in the side *a*; which, likewise carrying the index *c* before it, leaves its lower extremity at the point to which the column of that side had risen. In this manner, the *maximum* and *minimum* temperatures are seen at any desired interval of time; and all that is necessary to prepare

the instrument for a fresh observation is to bring down both indices to the surface of their respective columns by means of a magnet, which will act on the bit of iron wire included in the body of each index. From the above description, it is obvious, that there must be an *ascending* scale to measure the degrees of expansion in *b*, and a *descending* scale applied to *a*, to mark the contraction of the spirit. Mr. Six graduated his thermometers by placing them in water at different temperatures, and marking on his scales the heights corresponding to every 5° of a standard mercurial thermometer immersed in the same liquid. This elegant invention has become a common instrument; and on account of the ease with which the glass-spring of the index may be broken off, many instrument makers substitute a slender bristle, tied to the upper part of the index, and lapped round its body. This renders the spring less easily spoiled by the careless shifting of the index; but the hair, by being long steeped in spirit, is liable to have its elasticity destroyed; and a slender silver or platina wire would be preferable. The usual dimensions of the instrument are a bulb from 6 to 16 inches in length, and from 0.2 to 0.3 inch in internal diameter; the siphon, from the $\frac{1}{4}$ th to the $\frac{1}{5}$ th of an inch in width, and of a length proportioned to the size of the bulb; the indices about 1 inch long; the terminal expansion of the tube is, in most of the instruments now made, rather too small; in Six's original instrument, this part was a cylinder of 2 inches in length, by $\frac{1}{2}$ inch in diameter, to a bulb of 16 inches in length, and $\frac{1}{5}$ ths of an inch in internal diameter.

The chief defect of Six's thermometer arises, as in most other contrivances of this sort, from the unequal expansion of the spirit, and the introduction of two liquids of very different expansibility in the instrument; while, from the construction, it would be difficult to apply any general correction to its indications. It does not indicate the expansion of the spirit only, but also that of the mercurial column; which, where nice observation is required, would be of some moment; and the necessary friction of the indices will also tend to diminish the effect of expansion. Yet this instrument is a valuable addition to meteorology; and is probably the most convenient for ascertaining the temperature of the ocean at great depths, of any hitherto given to the public.—(*Library of Useful Knowledge*).

Rutherford's Day and Night Thermometers (Fig. 86) have now almost entirely superseded

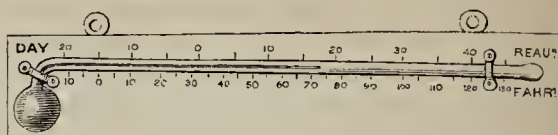
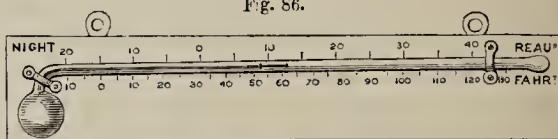


Fig. 86.



Rutherford's Day and Night Thermometers.

Six's instrument, being cheaper, more accurate, and not so liable to get out of order.

The Day Thermometer is a mercurial one, with a steel index, which is pushed forward by the mercury, and left at the highest point the latter has risen to, thus indicating the *maximum* temperature which has taken place since the last observation.

In the Night Thermometer, the index is of glass, and instead of mercury spirits of wine is the fluid employed. In consequence of the attraction between spirits and glass, the spirit, on contracting with cold, draws the index along with it towards the bulb; but on expanding with heat, passes freely up the tube without affecting the position of the index, which thus indicates the *minimum* temperature which has occurred since its last adjustment. In preparing the day thermometer for an observation, it is merely necessary to depress the bulb, and the index will glide back to the surface of the mercury; or by employing a magnet for the purpose, no disturbance of the instrument need take place. The index of the night thermometer is brought to the surface of the spirit by merely elevating the bulb.

Six's thermometer frequently becomes deranged, in consequence of a part of the alcohol passing from one leg of the tube into the other. Besides this inconvenience, the indices, if their springs are made of bristle, are apt to slip down in consequence of the bristle losing its elasticity; and thus may the whole object of the invention be defeated.

Rutherford's thermometers are liable to have the indices displaced by accidental shaking; and in the mercurial or day thermometer, the index sometimes gets immersed in the mercury; to guard against this, a small piece of enamel or glass should be introduced between the mercury and the index when the instrument is being made, and this is the prac-

tice of the first-rate makers. When these instruments get out of order, in consequence of the indices becoming entangled, or from the breaking of the column of fluid, the derangements may be remedied in the following manner:—"When this happens with the spirit thermometer, it may be rectified with ease by jerking the index down to the junction of the bulb and tube. The whole of the tube will, at the same time, become wetted with the spirit; and by setting it on end with the bulb downwards, the spirit will run together into one continuous column.

"When the steel index of the mercurial thermometer becomes immersed in the mercury, it must be jerked in the opposite direction, till it, with the mercury which may be above it, is projected into the little bulb at the top of the tube. If this do not succeed, heat must be applied to the mercury bulb; and when the index is fairly lodged in the air bulb, by carefully warming the mercury bulb with a spirit-lamp having a very small flame, the mercury must be made to expand till it rises to the very top of the tube, and projects convexly into the air bulb. The tube must then be placed upright, and, by tapping, the detached mercury will slip down beneath the steel index, and will fairly unite with the convex projection aforesaid. Now let the bulb cool, and the mercury will sink in one united column, and leave the index free."—(*Report of the Committee of the Royal Society on Physics, including Meteorology.*) In Rutherford's thermometers, also, it must be remembered that the end of the index nearest to the bulb must be taken in reading the *maximum* indication, and the end farthest from the bulb in reading the *minimum* one.

Self-registering thermometers, when used for indicating the extremes of temperature of the external air, should be placed so that they may neither be affected by the direct rays of the sun, nor by those reflected from water, buildings, rocks, &c. The bulbs should be sheltered from rain by a cover of oil-cloth, or similar material, placed at some distance above the instruments. The thermometers should be *fixed*, and not *hung*; and when Rutherford's are employed, so that one end may be lifted up to allow of the indices sliding back to the end of the fluid columns.

In reading all thermometers, care should be taken not to breathe upon or touch the instrument, or otherwise communicate heat

to it; and in night observations, not to affect it by the too close approximation of the light.

To the important influence exercised on vegetation by the temperature of the ground, it has been and will be frequently necessary to allude. And it is highly desirable that regular observations of temperature at certain depths below the surface of the ground, to which the roots of plants usually penetrate, may be undertaken, and their results made public.

The instruments used for ascertaining the temperature of the ground are called *geothermometers*, or *ground thermometers*. For this purpose various contrivances have been adopted. One of these, Bregazzi's Bark-bed Ther-

Fig. 87.*



mometer (Fig. 87), is used for ascertaining the temperatures of hot-beds, vinery borders, &c. It consists of a thermometer with a tube 2 feet in length, inclosed in a copper tube; into the top of this is inserted a wooden cylinder, containing the scale, which is inclosed by a door, in which a small thermometer, for indicating the temperature of the air, is fixed, that of the ground being of course shown by the other instrument. But for correct indications of ground temperature, a thermometer should be employed, the tube of which is sufficiently long that the whole of the scale may be seen above ground, when the bulb is plunged in the soil to the depth at which observations are to be taken. The glass tube and upper part of the bulb should be inclosed in a copper tube, and the intermediate space stuffed with powdered charcoal, cotton, or other non-conducting material, to prevent the communication of heat or cold from the air, and from the soil surrounding the tube. As the bulbs of geothermometers are usually made very thin, and are, consequently, very easily broken, the lower portion of the bulb should be protected by a copper guard. The instrument must be fixed in a perfectly upright position, with the centre of the bulb at the exact depth, and the copper tube should be closely packed round with earth.

The *Hygrometer* is an extremely useful instrument in the garden. By it the gardener

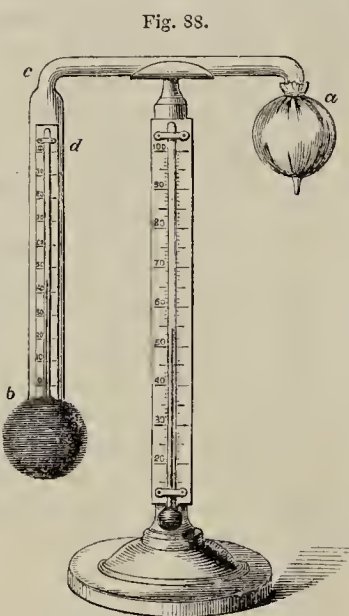
* Fig. 87.—Bregazzi's Bark bed Thermometer.

may ascertain the hygrometrical state of the air in green-houses, conservatories, &c.; and knowing this, he can maintain the degree of humidity best adapted for the growth of any particular plant or plants. Without such an instrument it is very difficult to do this, and the consequence in many cases is, the injury or death of valuable plants, either from being parched up, or from being kept in too moist an atmosphere. Besides being valuable for the above purpose, the indications of an hygrometer placed in the open air, combined with observations of the barometer, afford a better criterion of the weather and the probability of rain, than can be obtained by the use of either instrument alone.

Many different sorts of hygrometers have been invented by Saussure, De Luc, and others; but the best are Daniell's, and the Dry and Wet Bulb Hygrometer.

Daniell's Hygrometer (Fig. 88), which is more delicate than any other, was the invention of the late

talented Professor Daniell, who gives the following description of the instrument, and the mode of using it:—*a* and *b* are two thin glass balls of $1\frac{1}{4}$ inch diameter, connected together by a tube, having a bore about one-eighth of an inch. The tube is bent at right angles over the two balls, and the arm,



b c, contains a small thermometer *c*, whose bulb, which should be of lengthened form, descends into the ball *b*. This ball having been about two-thirds filled with ether, is heated over a lamp till the fluid boils, and the vapour issues from the capillary tube, which terminates the ball *a*. The vapour having expelled the air from both balls, the capillary tube is hermetically closed by the flame of a lamp. This process is familiar to those who are accustomed to blow glass, and may be known to have succeeded after the tube has become cool, by reversing the instrument and

taking one of the balls in the hand, the heat of which will drive all the ether into the other ball, and cause it to boil rapidly. The other ball, *a*, is now to be covered with a piece of muslin. The stand is of brass, and the transverse socket is made to hold the glass tube in the manner of a spring, allowing it to turn and be taken out with little difficulty. A small thermometer is inserted into the pillar of the stand. The manner of using the instrument is this: after having driven all the ether into the ball *b*, by the heat of the hand, it is to be placed at an open window, or out of doors, with the ball *b* so situated that the surface of the liquid may be upon a level with the eye of the observer. A little ether is then to be dropped upon the covered ball. Evaporation immediately takes place, which, producing cold upon the ball *a*, causes a rapid and continuous condensation of the ethereal vapour in the interior of the instrument. The consequent evaporation from the included ether produces a depression of temperature in the ball *b*, the degree of which is measured by the thermometer *c*. This action is almost instantaneous, and the thermometer begins to fall in two seconds after the ether has been dropped. A depression of 30° or 40° is easily produced, and I have seen the ether boil, and the thermometer driven below 0° of Fahrenheit's scale. The artificial cold thus produced causes a condensation of the atmospheric vapour upon the ball *b*, which first makes its appearance in a thin ring of dew, coincident with the surface of the ether. The degree at which this takes place is to be carefully noted. A little practice may be necessary to seize the exact moment of the first deposition; but certainty is very soon acquired. It is advisable, when the instrument has been constructed with a transparent ball, to have some dark object behind it, such as a house or a tree; as the cloud is not so readily perceived against the open horizon. The depression of temperature is first produced at the surface of the liquid, where evaporation takes place; and the currents, which immediately ensue to effect an equilibrium, are very perceptible. The bulb of the thermometer, *c*, is not quite immersed in the ether, that the line of greatest cold may pass through it. In very damp or windy weather the ether should be very slowly dropped upon the ball, otherwise the descent of the thermometer will be so rapid as to render it extremely difficult to be certain of the

degree. In dry weather, on the contrary, the ball requires to be well wetted more than once, to produce the requisite degree of cold. It is obvious that care should be taken not to permit the breath to affect the glass.—(Daniell's *Meteorological Essays*.)

Sulphuric ether is the sort employed, and it is necessary to observe that the ether should be of the best quality, otherwise great difficulty will be experienced, and much ether wasted, even in lowering the temperature a few degrees. Strong ether, though it cost more at first, is the cheapest in the end, for a much less quantity will be required.

The *Dry and Wet Bulb Hygrometer* consists of two thermometers, the readings of which, when both bulbs are uncovered, should be identical. One of the bulbs is uncovered, the other is covered with thin muslin, to which is attached a conducting thread of cotton lamp-wick, the other end of which is immersed in water. The evaporation from the water thus conveyed to the covered bulb produces cold, and the difference in the indications of the two thermometers is the degree of dryness as measured by this instrument. The instrument is represented in Fig. 89, where *a* is the dry bulb thermometer fixed to its scale; *b*, the wet bulb thermometer, fixed to its scale; *c*, the bulb of the dry thermometer, which is uncovered; *d*, the bulb of the wet thermometer, covered with thin muslin; and *e*, the conducting thread passing from the bulb *d* to the water-vessel. Directions for the use of this instrument, together with a set of hygrometrical tables, which should be procured by every one using it, have been published by Mr. Glaisher, of the Greenwich Observatory.*

The *Barometer* is an instrument constructed for the purpose of ascertaining the pressure

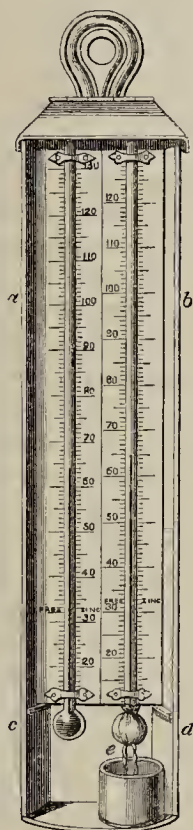
of the atmosphere. It is frequently called a *weather-glass*, from its indications affording a means by which the probability of changes in the weather may be predicted. It is also employed for measuring heights.

The principle upon which the construction of all barometers depends is, that the atmosphere presses equally in every direction with a weight amounting to about $14\frac{3}{4}$ lbs. on each square inch at the level of the sea. This pressure is, however, subject to considerable variations; and it is to measure these that the barometer is employed.

The mode in which this instrument is constructed is very simple. Let a glass tube of 34 inches in length, clean and perfectly dry, be completely filled with mercury; close the open end with the finger, and inverting the tube, plunge it into a cistern of mercury; on withdrawing the finger, the mercury in the tube will sink to some point between 28 and 31 inches above the level of the mercury in the cistern. If a scale, the graduation of which commences at the level of the mercury in the cistern, be attached to the tube, the apparatus will become a barometer, and one of the simplest construction. The space between the top of the mercurial column and that of the tube will neither be occupied by air, nor any other body, if the experiment has been properly conducted; for it will be a vacuum, the mode of forming which was discovered by Torricelli, the inventor of the barometer, hence it is called the Torricellian vacuum.

In accordance with a fundamental principle of hydrostatics, if a fluid is at rest in any vessel, every part of the surface of that fluid will be on the same level, no matter what may be the form of the vessel containing it. Hence, if water or any other fluid be poured into vessels communicating with each other, it will rise to the same level in both. But if in one vessel a greater pressure were exerted on its surface than in the other, the fluid would rise to a greater height, and in proportion to that pressure, in the vessel in which the least pressure was exerted on its surface. If two tubes, open at top, but closed and communicating with each other at bottom, and of the respective lengths of 40 and 80 inches, be placed in an upright position, and mercury be poured in, it will stand at the same height in both tubes. Let mercury now be poured in till both tubes are filled to the height of about

Fig. 89.



Dry and Wet Bulb Hygrometer.

* *Hygrometrical Tables*, by James Glaisher, Esq. London: R. and J. E. Taylor, Red Lion Court, Fleet Street.

40 inches. This having been done, let two pistons of equal weight be fitted closely, one into each tube, the mercury will still stand at the same level in both tubes; but if the piston of the short tube be loaded with a weight equal to 30 lbs. on each square inch of its surface, and the piston of the long tube be loaded with only 15 lbs. to the square inch, the mercury in the latter will rise until a sufficient quantity be elevated to balance, by its weight, the difference in the pressure on the surface of the mercury in the two tubes, namely, 15 lbs. on the square inch, and the mercurial column in the long tube would be about $30\frac{1}{2}$ inches higher than in the short one. If any other unequal weights were used, a quantity of mercury would always be elevated in the one tube, the weight of which would be sufficient to balance the extra pressure in the other.

From the preceding, the reason of the elevation of the mercury in the tube of the barometer above that in the cistern will be easily understood; for the mercury in the former is subjected to no pressure, whilst in the latter it is pressed upon by the weight of the atmosphere, about $14\frac{3}{4}$ lbs. on the square inch. Accordingly, mercury is elevated in the tube until, by its weight, it balance the pressure of the atmosphere on the surface of the mercury in the cistern. As the weight of the atmosphere varies at different times, so must the pressure on the surface of the mercury in the cistern; when this is less, a less weight of mercury will be required to balance it, and when more, a greater weight; accordingly, the mercury in the tube rises as the pressure of the atmosphere increases, and falls as it diminishes. When the mercury is high, the atmosphere is heavy; when low, the atmosphere is light.

If a hole were bored in the top of the barometer tube, and air admitted, the mercury, being subjected to equal or nearly equal pressure, both in the tube and in the cistern, would stand at the same level in both; and this is another proof that it is by the pressure of the atmosphere that the mercury is elevated in the tube.

Having now explained the principle upon which the action of the barometer depends, it only remains to describe the usual form of the instrument, and the mode in which its indications are read.

Though any liquid might be employed in

the construction of barometers, yet mercury is the one commonly used; for not only is it more uniform than other fluids in its expansion, but on account of its being the heaviest fluid known at common temperatures, a much shorter tube is necessary to contain the same weight than would be the case if any other liquid were employed. Besides these advantages, it is not liable to waste from evaporation, and may be rendered entirely free from air and moisture, which, if present, would materially interfere with the action of the instrument. Water, however, may be employed; but as mercury is rather more than thirteen and a half times heavier than water, a column of the latter, nearly 34 feet in height, would be required to produce the same effect as one of mercury 30 inches in height; so that, allowing for range and expansion, a tube not less than 38 feet in length would be necessary; and this would not only be very inconvenient, but would place portability out of the question. A water barometer, the tube of which was 40 feet long, was erected in the apartments of the Royal Society at Somerset House. A barometer filled with linseed oil was also constructed by Howard.

There are several forms of the mercurial barometer, and though the principle of all is the same, they vary considerably in the accuracy of their indications. We shall confine ourselves to describing one of the best, namely, Newman's Standard, which is the one employed by the Royal Society, and in most observatories; and one of the worst, the common wheel barometer.

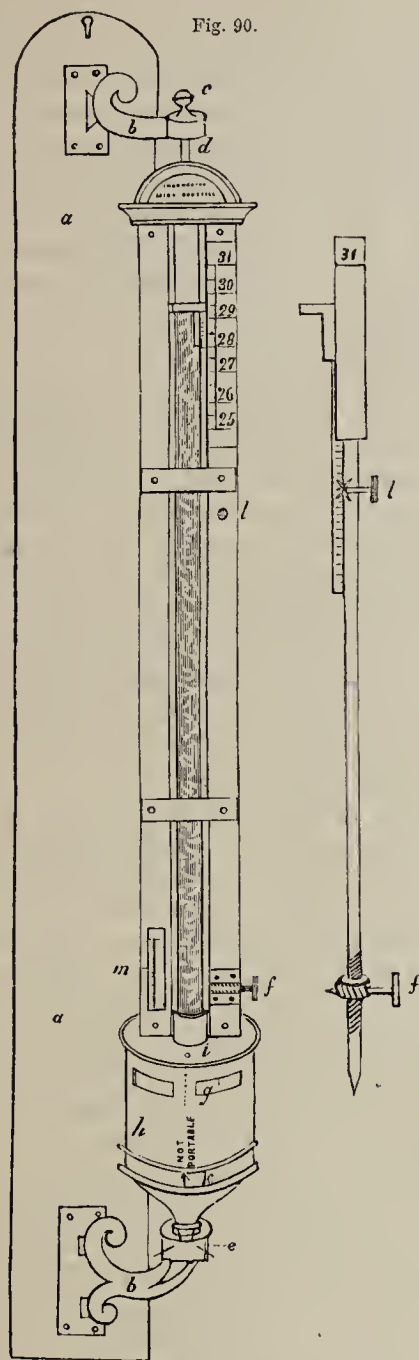
Newman's Standard Barometer.—Of this instrument, we have been furnished by Mr. Newman with the following description and the engraving, Fig. 90:—*a a*, the mahogany board to affix against the wall: *b b*, brackets which support the barometer, between which it is capable of being revolved, so as to observe the light on the surface of the mercury: *c*, vase, which unscrews to allow of the socket *d* being removed to receive the upper end of the barometer: *e*, the adjusting screws for shifting the lower centre, by which the barometer is to be brought exactly perpendicular—to accomplish this, the ivory point is to be adjusted to the surface of the mercury, the barometer gently turned between the two brackets; and if in any position the point should be elevated from the surface, or depressed into the mercury, the screws must be

altered accordingly, until the point coincides in every position: *f*, the key by which the

the cistern, on which the index \uparrow is engraved: *l*, the key by which the vernier is adjusted: *m*, the thermometer dipping into the cistern, showing the temperature of the mercury in the instrument.

With regard to the placing of the barometer, the *Report* of the Committee of the Royal Society contains the following instructions:—"The barometer should be placed in an apartment subject to as little variation of temperature as possible, and in a good light; and to facilitate night observations, an arrangement should be made for placing behind it a light, screened by a sheet of white paper, or other diaphanous substance. Great care should be taken to fix it in a perpendicular position by the plumb-line. Its height must be carefully ascertained above some permanent and easily recoverable mark, either in the building in which it is situated, or in some more permanent building, or rock, in its immediate vicinity; and no pains should be spared to ascertain the relation which such mark may bear to the level of high and of low water at spring-tides, and ultimately to the mean level of the sea."

The instrument being fixed in its position, the following is the mode in which its indications are read:—The ivory point terminating the brass scale, must be very carefully brought down to the surface of the mercury in the cistern, by means of the screw for that purpose, and the two are known to be exactly in contact when the ivory point and its reflection appear just to touch one another. The vernier must next be adjusted to the surface of the mercury in the tube. This is done by bringing down or raising up the vernier till its back and front form a tangent to the surface of the mercury so as just to exclude the light. The index will then point out on the scale the height at which the mercury stands. The inches are read on the first column of the scale; the tenths on the second; and the hundredths are found by looking at the third column of the scale, which is divided into half-tenths. If the index point above one of these divisions, the hundredths are more than five in number; then looking at the divisions of the first column of the vernier, a line will be found that coincides with one of the divisions of the scale above this, and on the second column of the scale of the vernier will be found a number, and this will be the number of hundredths. But if the index point above



Newman's Standard Barometer.

ivory point is adjusted—the ivory point being a termination of the brass scale marked off at the temperature of 32° , and which is adjusted by means of a tangent screw: *g*, the glass part of the cistern, through which the surface of the mercury and ivory point are seen: *h*, the cistern: *i*, the screw which is to be loosened when the barometer is fixed, to admit the atmospheric pressure: *k*, the moveable part of

one of the half-tenth divisions on the third column of the fixed scale, the half-tenth that is five hundredths must be added to the number already found; by counting the divisions on the first column of the vernier between the numbered degree last found, and where the two lines coincide, the number of five-hundredth parts will be ascertained, and this being written as a decimal, must be doubled, and will then count as thousandths. Thus, the height of the mercury may be measured to the five-hundredth part of an inch with ease and accuracy, and without the assistance of a lens.

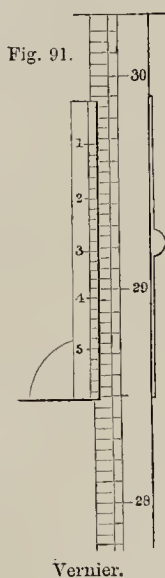
To render the above description of the method of reading the vernier clear, an example is necessary. Fig. 91 represents the vernier adjusted to the surface of the mercury; we see at once that the index points above 29 inches. Then, inspecting the second column of the scale, it is apparent that there are eight-tenths in addition; the reading thus far is, therefore, 29.8. On looking at the third column, we find that there is a half-tenth, making 29.85; but the index is still above this point, we must, therefore, look in the first column on the vernier for two lines which coincide; this is the case between the divisions 3 and 4, three-hundredths must therefore be added to the five already found, making the reading 29.88; counting the small divisions on the first column of the vernier, we find that between the divisions marked 3, and the place where the two lines coincide, there are three of the small divisions or five-hundredths, each of these counting as two-thousandths, we have six-thousandths, and the reading is, therefore, 29.886. In making the adjustments, and also in reading, a magnifying glass is of great assistance to the eye.

Although the height of the mercurial column is correctly measured in the above manner, yet several corrections are necessary before the true height of a column of mercury at 32° is found. These corrections are for *capillary action* and temperature; and in barometers the scales of which are fixed, and cannot be adjusted to the surface of the mercury in the cistern, a correction for *capacity* must likewise be applied.

The effect of the capillary action of the barometer tube, is to cause a depression of the surface of the mercury in the tube. The amount of this depression is greatest in tubes of small diameter; likewise in those not boiled after filling. In an unboiled tube, of $\frac{1}{2}$ inch in diameter, the correction on account of capillary action only amounts to 0.007 inch, and in a boiled one of the same width to 0.003 inch. The amount of correction for capillary action has always to be added to the indications, and it is ascertained, by experiments during the construction of the instrument, and marked upon it.

The next correction is that for temperature. In consequence of the expansion or contraction of the mercury, either more or less than the true height of a column of mercury at 32° would be indicated, according as the temperature of the mercury might be above or below that point. The instrument is therefore furnished with a thermometer, the bulb of which dips into the mercury in the cistern, indicating the temperature of the mercury, which must be ascertained at each observation, and registered together with the uncorrected observation.

The correction for capacity, as previously stated, is necessary in instruments the scales of which cannot be brought down to the level of the mercury in the cistern. At the time these scales are fixed, they are adjusted to the level of the mercury in the cistern, and the height at which the mercury then stands in the tube is called the *neutral point*. Now, it must be evident, that whenever the mercury in the tube stands above the neutral point, the level of the mercury in the cistern must sink below the zero of the scale, in consequence of a part of the fluid passing into the tube; and that when the mercury falls below the neutral point, it must rise above the zero by reason of mercury being discharged into the cistern. It will be evident that the quantity of mercury withdrawn from the cistern, or discharged into it, in consequence of the mercury in the tube rising above, or falling below the neutral point, will be in proportion to that rise or fall, and to the relation which the capacity of the tube bears to that of the cistern. For instance, if the capacity of the cistern be fifty times that of the tube, and the mercury in the latter rise 1 inch above the neutral point, the mercury in the cistern will be lowered beneath the zero of the scale $\frac{1}{50}$ th of



an inch, and that amount must therefore be added to the observed height; but if, on the other hand, it fall the same distance below the neutral point, a corresponding amount must be subtracted on account of the mercury in the cistern rising above the zero of the scale. The correction for capacity must therefore be made by dividing the difference between the observed height of the mercury, and the neutral point, by the relation which the capacity of the tube bears to that of the cistern, and *adding* the product if the observed height is above the neutral point, and *subtracting* it when it is *below*. The neutral point and correction for capacity should always be marked on the instrument.

In the *Report* of the Committee of the Royal Society on Physics, including Meteorology,* will be found excellent tables of the corrections to be applied to barometers on account of temperature, capillary action, and capacity, as well as much useful information respecting the making and registering of meteorological observations.

The wheel barometer consists of a tube bent in the form of an **U**, one leg of which is about 34 inches longer than the other. As the pressure of the air increases, or diminishes, the level of the mercury in the short leg will be lowered or raised accordingly; and the difference between the levels of the mercury in the two legs, will be the height of a column of mercury balancing the pressure of the atmosphere. In the short leg is a float having a string attached, from the other end of which is suspended a weight, nearly balancing the weight of the float. The string passes over a pulley, which it moves when the float rises or falls, and this pulley is connected with hands, which, playing upon a graduated dial, indicate the pressure of the atmosphere.

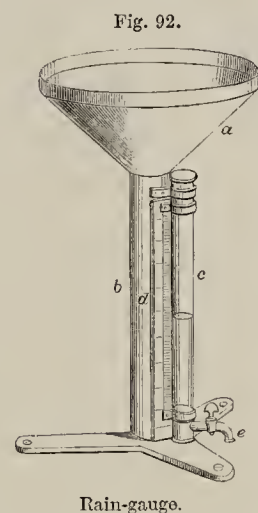
Wheel barometers, though they may answer tolerably well as *weather-glasses*, are quite unfitted for meteorological observations, for their indications are only approximations to the truth, requiring corrections of a very complicated nature, which are never made.

The *Rain-gauge* is an instrument which ought to find a place in every garden. To the gardener its indications afford much assistance in judging of the quantity of water which in dry weather must be artificially

supplied to trees and other plants. The former frequently suffer from dryness at the root long before the effects of this deficiency of moisture become visible. This may, in most cases, be obviated, by observing the amount of rain which has fallen; and if it is known to be less than is requisite for the maintenance of trees in a healthy and vigorous state, the deficiency must be made up by an artificial supply of water. Again, in draining, the capacity of the main channels must be regulated according to the quantity of rain which falls on a certain extent of ground in the locality; and to ascertain this, the rain-gauge becomes necessary.

"The rain-gauge may be of very simple construction. A cubical box of strong tin or zinc, exactly 10 inches by the side open above, receives at an inch below its edge a funnel, sloping to a small hole in the centre. On one of the lateral edges of the box, close to the top of the cavity, is soldered a short pipe, in which a cork is fitted. The whole should be well painted. The water which enters this gauge is poured through the short tube into a cylindrical glass vessel, graduated to cubic inches and fifths of cubic inches. Hence, 1

inch depth of rain in the gauge, will be measured by 100 inches of the graduated vessel, and $\frac{1}{1000}$ th of an inch of rain may be very easily read off."—(*Report of the Committee of the Royal Society on Physics, including Meteorology.*)



Another form of rain-gauge is represented in Fig. 92. It consists of a copper funnel *a*, having an opening below of $\frac{1}{4}$ inch in diameter, fastened to a cylindrical tube *b*. At the side of the tube *b*, and having a communication with it below, a glass tube, *c*, is placed, to which is attached a graduated scale *d*, and a copper or brass cock *e*, for letting off the water collected in the tubes. Water, in accordance with a well-known law of hydrostatics, will rise to the same height in both tubes, and the amount of rain may easily be measured by the scale. The graduation of the scale is effected in the following manner: enough water is poured into the funnel to rise above the brass

* London: R. and J. E. Taylor, Red Lion Court, Fleet Street.

ring which fastens the glass tube just above the cock *c*. Thus is formed the zero point of the scale, and enough water must always be kept in the gauge to stand at the level of this point. The area of the horizontal surface included by the rim of the funnel being found, the quantity of water sufficient to cover this to a certain depth may be easily calculated. In graduating the scales of rain-gauges, a quantity of water equivalent to $\frac{1}{10}$ th of an inch of rain should be employed. This is found in the following manner: suppose the area to be 100 square inches, then $100 \times \frac{1}{10} = 10$ cubic inches, the quantity of water sufficient to cover a surface of that extent to the depth of $\frac{1}{10}$ th of an inch. The weight of an equivalent measure of water may be found by multiplying the weight of a cubic inch of water at 62° and 30 bar., 252.458 grains by the number of cubic inches necessary; thus continuing with the previous example, $252.458 \text{ grs.} \times 10 = 2524.58 \text{ grs.}$, or 5 oz. 5 dwts. 4.58 grs. troy, and this is the weight of water equal to a fall of $\frac{1}{10}$ th of an inch of rain, on a receiving surface of 100 square inches.

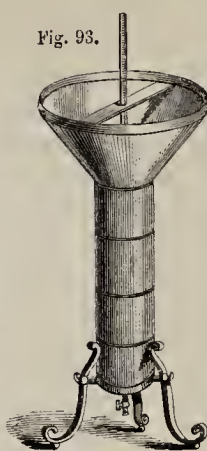
The quantity of water ascertained to be equal to $\frac{1}{10}$ th of an inch of rain, is then poured into the funnel, and the height to which it rises is marked on the scale, and this mode of proceeding is continued until a sufficient number of divisions are made; these again are divided into ten parts, each of which will be equivalent to $\frac{1}{100}$ th part of an inch of rain, and the graduation is complete.

As the area of the horizontal surface presented by the funnel is many times that of the united areas of the two tubes, an inch of rain will occupy several inches on the scale, and in this way a minute quantity of rain may be easily read. For instance, suppose the area presented by the funnel to be 100 square inches, and that of the tubes to be only 10 square inches, then, as $10 : 100 :: 1 : 10$, or the division of the scale which would indicate an inch of rain, would be 10 inches in length. In the same way, $\frac{1}{10}$ th, or $\frac{1}{100}$ th of an inch of rain, would be indicated by divisions of the respective lengths of 1 inch, and of $\frac{1}{10}$ th of an inch.

In some rain-gauges, one of which is represented by Fig. 93, a float is used, which, by its rising, indicates the amount of rain which has fallen. These instruments consist of a funnel, the top of which may be rectangular or circular, joined to a rim, the edge of which

must be made perfectly true. A small rod with a loop in the middle to admit the index-

Fig. 93.



Rain-gauge.

rod which is attached to a float, extends from side to side across the funnel. The tapering end of the funnel is inserted into a copper cylinder made as true as possible, and furnished with a cock at bottom. The float is also made of copper, and should fit the cylinder closely, no more room being allowed than is sufficient to permit the float to rise and fall freely, and the water to descend into the lower part of the cylinder. If the funnel were circular, and the cylinder made of exactly the same diameter throughout, the length of the divisions on the index-rod could be easily calculated; for, as the areas of circles are to each other as the squares of their diameters, the square of the diameter of the funnel divided by the square of the diameter of the cylinder, would be the length in inches of a division on the index-rod, corresponding to a fall of rain to the depth of 1 inch on the horizontal surface presented by the funnel. Nevertheless, the practice of the best makers of these instruments, is to graduate the scale by means of water, in the same way as in the preceding sort of rain-gauge, because it is extremely difficult to form a true cylinder of sheet-copper. In frosty weather, the float should be suspended out of contact with the water, and only let down when an observation is to be taken, otherwise it will be injured.

Rain-gauges of the above description possess the advantage of not being subject to any appreciable loss of water by evaporation, this being almost entirely prevented by the float, especially when the latter fits the cylinder so as to have no more clear space than is absolutely necessary.

The rain-gauge should always be placed so that the edge of the funnel may be perfectly horizontal; it must also be at a distance from houses, trees, or other natural objects which may interfere with rain falling in an oblique direction.

I have endeavoured to explain, as clearly as possible, the mode in which the graduation of the scales of rain-gauges is effected, in order that those who may be desirous of possessing

one of these useful instruments, but unwilling to go to the expense of obtaining it from a philosophical instrument maker, may, if possessed of a little ingenuity, construct one themselves, which will indicate the amount of rain with sufficient accuracy for practical purposes.

But if the observations are undertaken with the view of contributing to the science of meteorology, an accurate instrument should be procured from a skilful philosophical instrument maker.

The Vane.—For the purpose of ascertaining the direction of the wind, a vane is necessary. This instrument is made of various shapes and sizes; but it is frequently constructed badly, and fixed in an improper position. On this subject, Mr. Howard, in his *Climate of London*, makes the following excellent remarks:—

“As to *form*, it should be simple, to insure durability; and such as that the *resisting surface* may be as nearly as possible confined to *one side of the spindle*. It is curious to observe how this principle is commonly violated on our public edifices. Either some inelegant caprice takes possession of the architect or artificer, or it is taken for granted that a new vane must be unlike any old one in existence. The shortest way to convince the workman on this point, will be to propose to him to solve the probable effect as to resistance of making a vane alike on both sides: as he will soon see that such a vane would be continually taken on its broad side by the wind; and, consequently, that every *approach* towards this equality of resistance must both diminish steadiness, and increase the strain on the spindle.

As to *suspension*, a spindle of hard iron, tapering to a point not finer than that of a crayon, should enter into a tube stopped by a harder substance. A *flint*, having a smooth concave face on one side, will answer for this; and it may be fixed in a socket as much larger than the tube itself as is necessary, and so joined to the tube. The spindle is likewise to pass through guides inserted in the tube, and to be sufficiently long to allow for subsidence by wear at top. On it the moving part should rest in equilibrium. The counterpoise is best made by a loaded ball, carried out to the proper distance, which may be found by trial before fixing it, on a slender single or double branch of iron. The whole is to be kept down on the spindle by means of a second and larger, moderately loaded ball,

mounted on the centre of the vane, and turning with it.

There are vanes to be had ready-made in London, which fulfil pretty nearly these conditions, that of great durability excepted. This is best insured where expense is not an object, by using copper well gilt for the material.

As to *position*, it is obvious that this instrument ought to be clear of deflections and eddies, from objects on the same or a higher level. That it may the more easily be so placed, the spindle may end in a taper shaft, capable of receiving a fir pole; the latter should be well painted before fixing, and the vane put on and adjusted after it is fixed.

In this stage of the business, the workman will require a compass, if letters are as usual attached to the vane; and he must observe that when the needle, by moving the compass round, is made to point to the *variation* north, the north on the card will be the point for the north of the vane.”

VII.—MISCELLANEOUS ARTICLES.

Tallies.—No mode of numbering plants can excel that in which the Arabic figures are employed; for these being the most universally known, can be more easily read, and with less risk of mistake than any other. But in many cases, painting numbers in a manner not liable to be soon effaced by exposure to the weather, would occupy too much time, and would prove too expensive. Accordingly, marks to represent numbers are cut on wood, and these cuts remain visible till the wood gets into a state of complete decay; for although the surface of the tally must waste more or less, according to the nature of the wood, by the action of the weather, yet, as the face wastes, the notches cut in it deepen from the same cause in an equal or even greater degree. The Arabic figures, with the exception of No. 1, cannot be quickly and well cut on wood with a knife. Nos. 4 and 7 require each a combination of three cuts, and all the others are circular in their formation, and too difficult to imitate. Unquestionably the best method is that by which the numbers are represented with the fewest cuts, and those most easily made. In these respects, *Seton's method* has the advantage of various others that have been proposed. The digits are represented in Fig. 94. It will be observed that none of the units require for their formation more

than two strokes, and that the whole series, from 0 to 9 inclusive, is formed by thirteen



cuts and three notches. This cannot be done by any other known method, with so few; and, whilst this is the case, Seton's method must be considered the simplest and best. In this the characters all consist of straight lines; and each for the respective units is either simple, as 1, 2, 3; or composed of not more than two lines, 4, 5, 6, 7; whilst 8 and 9 are each represented by a single line and a notch. In cutting these lines, or bars, care should be taken that the 2 and 3 are made with a decided slant, so as not to be mistaken for 1. In 6, the right-hand stroke must be either square across, or it should preferably incline a little inwards towards the left, in order that it may not be mistaken for 4; the upright bar of 7 should incline towards the right for the same reason.

These characters, from their simplicity, are easily understood; but notwithstanding this, they may be mistaken for each other, such as 2 for 3, 6 for 7, 8 for 9, and *vice versa*. In order to avoid this, it will be advisable to observe well, when first learning, that the slant of 2 is to the left at bottom, like the strokes of common writing; 3 slants the reverse; 6 and 8 slant to the left; 7 and 9 to the right. It should also be recollected that of any two numbers liable to be mistaken for each other, the lower one slants to the left like common writing, and the higher to the right. A great advantage in using these numbers is, that they read exactly like those of the Arabic system, each additional figure increasing the previous value of the series tenfold, besides adding that of its own; thus—**IA** is 14, **IAV** is 145, and 1857 is represented by **I/VN**. The numbers should be cut and read from the end of the tally placed in the ground.

Painted tallies, for temporary use, are slightly rubbed with white paint, and written upon with a black-lead pencil whilst wet. Some composition pencils, of which the marks on paper cannot be effectually rubbed out by india-rubber, are preferable to those of genuine plumbago. Red chalk is found to withstand the weather, and to remain legible for many years. It is more durable than black-lead.

Cast-iron Tallies, about 1 foot in length, with an oval top surrounded by a rim, with which the numbers are raised in the casting, are very durable if dipped in boiling linseed oil. This will almost entirely prevent rusting, at least above ground, for more than twenty years. When rust appears, they may be put in the fire, cleaned, and re-dipped.

An Iron Tally coated with zinc (Fig. 95),



Tree Label.

with sides projecting so as to admit of a piece of glass being puttied over the name, answers well. The metallic face is painted white, and on this ground, when dry, the name is painted black. Afterwards, when perfectly dry, the tally is glazed. When being glazed, the tally should be warmer than the air of the place in which the operation is performed. Putty that has been kept moist by immersion in water should not be used. Some very excellent kinds of tallies are made of earthenware, on which numbers are stamped in, previous to burning, or names are burned in.

Bricks set endwise in the ground, with a name or number painted upon them, are also frequently employed.

Labels made of lead, and having the number or names stamped in, are very durable, provided they be securely fixed, as when nailed against walls; but unless of small size, they are objectionable when suspended, because the wires cut their way out. For labelling plants or cuttings for travelling, tapering slips of sheet lead answer very well. The number is stamped on the broad end, and the slip is then rolled tight on the branch or stem of the plant. Small lead labels, just sufficiently large for a number to be stamped on them, are sometimes used; these should be attached to the branch of the tree by copper wire. Zinc labels are frequently used; but if suspended from the plant, their edges are apt to injure the bark. When placed where there is no danger of this occurring, they answer exceedingly well. A number may easily be stamped in; they may also be written on with an ink composed of verdigris in powder—1 drachm, sal-ammoniac 1 drachm, lamp-black $\frac{1}{2}$ drachm, and water 10 drachms; or, if rubbed over with white lead paint, a black-lead pencil may be used for the same purpose.

Parchment labels are very generally employed for the temporary labelling of plants; but they are apt to become almost like a jelly, when kept close and damp, and the ink spreads, so that instead of letters, it exhibits a mere stain. A great improvement consists in giving the parchment a coat of white lead. It may then be cut into slips of the required size, and written upon, either with pencil or ink. The white lead gives a firm surface to the label, so that the latter remains flat, without acquiring a gelatinous consistence with damp, or shrivelling up with drought.

Nail Bag.—A bag or large pocket for holding nails and shreds, whilst nailing wall-trees, &c., may either be made of stout close canvas, or of leather. In the latter case it sometimes contains one or two small pockets for knives. It is suspended by shoulder straps, and further secured by a belt. All this may be necessary in nailing against very high walls; but in ordinary cases, the canvas answers the purpose sufficiently well, and is at all times more pliable.

Scrapers.—Where gravel walks have frequently to be entered upon from the cultivated soil, there should be scrapers of some kind or other. They should be of cast-iron, for old spades, a piece of hoop-iron, or a piece of old scythe, fixed between wooden stumps, have a barbarous appearance. A narrow plate of iron, exhibiting some adaptation for the purpose, and screwed on wooden supports, is not so objectionable, and may be adopted in small gardens.

Hand-glasses are made in various shapes; but their bases are generally square, hexagonal, or octagonal; but now that glass is cheap, and that sheet-glass can be obtained of sizes corresponding with those of the sides, the preference is given to hand-glasses with only four sides. The frame-work is usually constructed of lead, copper, or cast-iron, the latter, if kept painted, answers well.

The hand-glass with a cast-iron framework

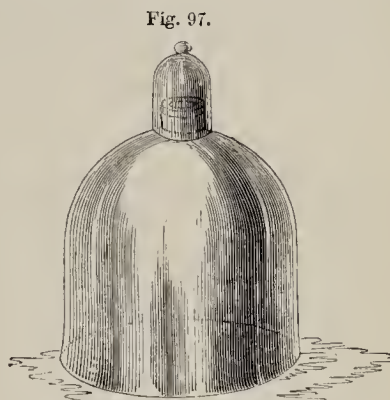


(Fig. 96) is very durable and convenient; the

top being moveable, air can easily be given without lifting the glass or injuring the leaves of the plant in replacing it; and by placing two or three of the lower portions above each other, a protection of greater height may be formed.

Bell-glasses of green glass, and of large size, are used in the open ground for protecting and forwarding vegetables, &c. Others of less size, and made of whiter glass, are employed in propagating.

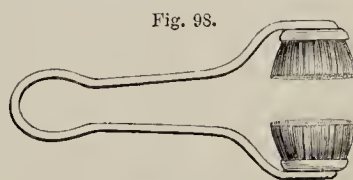
Fig. 97 is an improved form of bell-glass,



Pilkington's Bell-glass.

for protecting vegetables, invented and manufactured by Mr. Pilkington, of St. Helen's, Lancashire. By removing the small bell-glass placed over the neck of the larger one, air may be admitted without lifting the latter, or raising it up.

The *Aphis Brush* (Fig. 98), invented by the



Aphis Brush.

Rev. E. S. Bull, of Colchester, is useful for removing aphides from roses and other plants. The handle is of steel, and elastic. By the pressure of the fingers on one side, and that of the thumb on the other, the brushes are brought together upon the shoot to be cleaned, and the aphides are removed without injury to the plant.

Various other articles will be required in a garden, such as planks for wheeling; canvas, gauze, and nets of twine for protecting seeds and fruits from birds and other spoliators; wall nails and shreds; tarred twine, willows for tying, mats, stakes for plants; irons for clearing between furnace-bars, fire-shovels,

and other implements for pushing back or drawing forward the fuel; traps for vermin, and a great variety of other articles.

CHAPTER VIII.

FORMATION OF THE FRUIT AND KITCHEN GARDEN.

The principal considerations relating to the formation of the Fruit and Kitchen Garden are—1. SITUATION. 2. SOIL. 3. FORM. 4. EXTENT.

I.—SITUATION.

In choosing a site for a garden, it is desirable that the ground should either be level, or have a gentle slope to the south, south-east, or south-west. If the ground is naturally sloping, drainage can always be effected; but if it is level, care should be taken that that level is not so low as to prevent deep drainage, for this is of primary importance. A slope to the south-east is generally considered better than one to the south-west. Where there is a choice, we think that a slope a little to the east of south, or so as to face the sun at about eleven o'clock in the forenoon, is to be preferred. Steep slopes should be avoided, especially in parts of the country where the annual fall of rain does not average more than 24 inches per annum. In such parts, the ground selected should either be level, or not sloping more than 1 foot in 50. In very wet climates, a fall to the extent of 1 foot in 30 may be advantageous for early crops; but for walled-in gardens, such steeps are inconvenient. The base of a slope is a good situation, and on such the soil is generally of good quality from the washing down of the richer parts of the soil of the higher ground. "Ground possessing a gentle inclination towards the south is desirable for a garden. On such a slope effectual drainage is easily accomplished, and the greatest possible benefit is derived from the sun's rays. The lower part of a gentle declivity is perhaps to be preferred; but a very low situation should scarcely be chosen, as the subsoil is apt to be damp; fogs often brood over such spots, and frosts are more injurious than on higher ground. It is beneficial to have an open exposure to the east and west, so that the garden may enjoy the full benefit of the

morning and evening sun."—(Neill's *Fruit, Flower, and Kitchen Garden*.)

We have seen a garden formed so that the whole had a regular declivity from north to south, in which direction a walk divided the area into two equal portions, each of which likewise sloped uniformly towards the central walk. The garden was thus generally inclined to the south, whilst the one-half had an eastern inclination, the other a western. In this way the sun's rays have greater effect on the surface soil, from their being more perpendicular to it; and the water runs off, but not too rapidly. If the ground were level from north to south, and if it sloped only from both sides to the central walk, then the water would tend to flow directly from the sides towards the walk; but when the ground likewise slopes from north to south, the water will tend also to follow that direction, and its course will consequently be diagonal.

Gardens have to be made in many instances where a supply of water can only be obtained by sinking wells; but it would be exceedingly desirable if a running stream could be taken advantage of in choosing a site for a garden. If such flow in a natural channel, of course it will be in the lowest part of the ground, and, consequently, will not occasion wetness in other parts; but then it would, probably, be more labour to carry the water where wanted than to pump it from wells. If, on the other hand, a conduit is carried nearly level with the general surface of the garden, the water will pass through the banks, and keep the soil in a cold wet state, as has been frequently observed, unless the course be properly secured from leakage by stone or brick-work laid in cement. This sort of aqueduct style may be considered obsolete, since the conveyance of water by pipes has become so general. Although by means of pipes we can raise water from a source to any place not higher than that source, and although this may be done by means of pipes underground without causing any obstruction above, yet there are circumstances connected with the aqueduct system which renders it on some accounts desirable. It is well known that cold water applied even to kitchen garden crops in summer is injurious, and the more so the greater the difference between the temperature of the water and that of the soil, even if that difference should arise from an unusually hot state of the ground at the time. Spring water retains

an almost uniform temperature, nearly equal to that of the surface soil in March; but rising very little in comparison to the increase of heat in summer. Water conveyed in pipes, generally laid below the immediate influence of the sun's rays, partakes of the coolness of spring-water, and is on that account likewise objectionable. But when it is conveyed in an open channel, exposed to the sun and air, it acquires a much higher temperature, approximating to that of the soil, and is, consequently, much better for the growth of plants. From what has been stated, it is evident that the command of a stream of water is very desirable for a garden.

The situation, then, of the fruit and kitchen garden, considered with reference to itself, should be either on a level, but admitting of effectual drainage, or on a gentle slope, and preferably on the lower portion of a slope facing the south, or some point between south-east and south-west, so that it may be the more sheltered from northerly winds; whilst, at the same time, its inclination admits of the sun's rays acting with greater effect. A command of water from a higher source should also be kept in view.

A situation possessing these qualifications is of great importance, and should be taken advantage of, if there be no weighty reason to the contrary. If the mansion is already built, and if grounds laid out in ornamental style occupy the most desirable site for the fruit and kitchen garden, the latter must of course be placed in the next best situation that circumstances will permit. When the place is new, and a mansion has to be built, and gardens have to be formed, the gardener ought to be consulted as well as the architect. Fortunately these are not likely to differ about the quality of the soil, for the very poorest soil is the most healthy one for a house to be built upon, and that which the gardener would the least covet. The gardener should first select the situation which is most eligible for the garden; then the architect and landscape-gardener ought to settle between them upon the objects which they may respectively have in view.

"It may in general be remarked, that as a place of interest to every well-informed proprietor, the garden should be so near to the mansion as to be conveniently accessible on foot, probably within little more than $\frac{1}{4}$ of a mile; while it should be so distant as to avoid the possibility of offence arising from the ne-

cessary gardening operations, and the resort of workmen. A position on one side of the house is to be preferred, unless a more eligible one occur in the rear. Wherever it be placed, it should be so masked by evergreen shrubs, and by trees, as not to be visible from the principal lawn, or from the walks in the shrubbery and flower-garden. If the surface of the domain be undulating, the garden is almost unavoidably seen from some point or other, and the *coup d'œil* of the inclosure walls is apt to present the idea of a huge box; an unpleasant impression, which should be avoided, or lessened by plantations judiciously introduced."—(Neill's *Fruit, Flower, and Kitchen Garden*.)

The distance must depend upon the size of the mansion, and the corresponding extent of the surrounding pleasure-grounds. If these are extensive, the garden will probably require to be situated at more than $\frac{1}{4}$ of a mile, but a shorter distance than this would be desirable. And in proportion as the extent of the domain is limited, so also must be the distance of the garden from the house, till the former becomes quite attached to the latter; or the house, as in the case of small villas, may even be inclosed by the garden walls.

Some recommend the garden to be situated on the south side of the house, others on the north, others on the east or west, or on the south-east or south-west. When situated directly south from the mansion, the garden cannot be readily entered without coming in at the back of the glass structures, the first view being consequently the worst, perhaps, in the whole garden, that of sheds and other places, which are generally wished to be concealed as much as possible. If situated to the north, there is no such objection, the houses being then approached directly in front. But on the other hand, the garden, when north of the house, can rarely be screened from the mansion without raising a shade, which obstructs a considerable portion of the rays of light proceeding from the brightest portion of the sky. If, however, it is situated either on the east or west side of the mansion, the above objections will not apply; neither will they do so if the situation is chosen in a south-east or south-west direction from the mansion. But of all others the east is preferable, where the nature of the surface requires artificial shelter to be formed against the north and north-east winds. Supposing the

ground to be level, and the garden placed to the south-west, then to shelter it from the north and north-east winds, high trees at some distance, as they ought to be from the garden, would certainly interfere with the pleasure ground; whereas, if the garden is placed on the east side, the necessary shelter would be farther from the mansion than the garden itself, and therefore would not come within the space required for ornamental purposes.

II.—SOIL.

In treating of soils, the kinds most suitable for a garden were pointed out. A good loam, or a sandy loam mixed with humus, is the best. The former is better fitted for fruit-trees, but for early crops the sandy loam is desirable. Whilst the greater part of the garden should consist of such soil, either naturally or artificially formed, it would be very useful in some cases to have a portion stronger, and another much lighter, in order to suit some plants that require a strong soil, and others that require a very light one.

The depth of soil for a fruit and kitchen garden should be in general about 3 feet. If the situation is damp, the depth of soil may be $2\frac{1}{2}$ feet, or even 2 feet; but certainly not less than 18 inches. Nicol says it is necessary to have a depth of from 24 to 36 inches, and that when the natural soil is less than 24 inches, it is to be made up to that depth by *forcing*, that is, carrying in soil from the adjacent fields, for it is not advisable to trench up and mix *much* of the subsoil with it. Indeed, in many cases, gardens are almost ruined by the injudicious admixture of the subsoil with the surface mould.

The subsoil should also be examined, for if it is bad, or mixed with too much oxide of iron, a site ought to be sought for elsewhere, however suitable the top-soil may be. When this is good, trees of course will grow well for several years, or till their roots penetrate into the bad subsoil. Vitiated sap is then absorbed, and by the time that the trees should be in a full bearing state, they begin to exhibit symptoms of decay; and the hopes of their bearing good crops, and of their attaining a healthy old age, terminate in disappointment.

The choice of soil is affected by three considerations: the quality of the soil itself, the nature of the subsoil, and the position with

reference to the mansion, as already indicated. It may fortunately happen, that a good soil and subsoil exist in the most desirable situation, and when this is the case, the matter, of course, is easily settled. But the subsoil may be good, and the top bad, in that desirable situation; then it may be a question whether the two good qualifications should not be taken advantage of, and means adopted to remedy that which is objectionable as regards the top-soil. The solution of this question will depend on the amount of expense that may be required, or allowed, for improvement. If the top-soil is too thin, the necessary thickness must be made up by the introduction of proper soil from other places where it can be spared. The soil thrown out in digging for the foundations of walls, or other buildings, and for the bottoms of walks, should be economized for the purpose. If the requisite additional soil be taken from a field, the surface should only be removed in stripes, in order that the field may be injured as little as possible. A rich old pasture will afford excellent garden soil. The soil, it may be here remarked, should be taken in the way that will least injure the field. If we remove the entire surface from half the field, that half in most instances will not soon recover. But if the whole surface be lined off in strips, say 18 inches wide, and if only every other one be taken off a spit deep for the garden, and then if the field be trenched across the strips, and duly manured, it will soon recover its loss, which, in fact, by this mode will be scarcely apparent under good after-management; but even with such management, the bad effects of the entire removal of the surface has been visible for many years. The area of the garden being known, less that of the walks, and the depth of soil required to be added being also ascertained, the number of cubic yards to be drawn in can easily be calculated, and estimated for.

Then it becomes simply a question of expense, as to whether the garden can be formed in the best situation and on a good subsoil or not. It should be recollected that pleasure grounds can be laid out, and altered, if this should prove desirable; but such is not the case with a fruit and kitchen garden, surrounded by walls, and containing a greater or less number of horticultural structures. Therefore, to have it established in the best situation, although at some considerable ex-

pense for soil in the first instance, would be very desirable. Rather than it should not be so placed, a portion of the ground, say a half or one-fourth, including borders, and where trees are to be planted, could be done in the first instance; and soil could be collected as opportunities occur, for making good successive portions, till the whole is completed. Thus, objections which are merely applicable to the defects of the top-soil may be overcome.

Where the subsoil is at fault, the remedy is frequently not so obvious. If only some portions of it are bad, these may be removed and a better kind substituted. When oxide of iron is found in excess in the subsoil, the latter may in certain cases be laid over with concrete, or the oxides may be corrected by the application of lime or chalk, for if this be well rammed, the roots of trees will not readily penetrate through it; or if the ground be trenched about 18 inches deep, with drainage at the bottom of this depth, the oxides will be partly washed down, and carried off by the drainage water, and the injurious action of the remainder may be wholly or partly counteracted by the application of calcareous matter. By these means, the subsoil may be greatly improved; but in all cases where it is not naturally good, or not completely sealed by concrete or other substances from the access of roots, the top-soil should be made deep, so that there may be plenty of good nourishment for plants without their seeking after that which is indifferent or bad.

III.—FORM AND EXTENT.

As regards the cultivation of vegetables, the form of a garden is not of material consequence. With the exception of such as may require a south border, they will succeed as well in a piece of irregular ground as they will in one of any other shape. But when the area is not rectangular there is additional trouble and loss of time in digging, trenching, &c. As fruit and kitchen gardens are generally inclosed with walls, chiefly with the view of ripening fruits, the form of the garden, and consequently the relative lengths of these walls and the determination of their aspects, become important considerations. Much depends upon the more or less direct exposure which the surface of the wall presents to the action of the sun's rays, during the period of the day when they are most powerful. From

the following observations made by Professor Daniell, and recorded in his *Meteorological Essays*, that period appears to be between one and two o'clock P.M. The observations were made in the month of June. "The day was perfectly calm and cloudless, and the atmosphere so clear, that the disk of the moon was visible throughout the day. The dew-point by the hygrometer was stationary at 57°."

Progress of Solar Radiation from Morning to Evening.

THERMOMETER.			
Time.	In Sun.	In Shade.	Difference.
9 A.M.	93°	68°	25°
9½ "	103	69	34
10 "	111	70½	40½
10½ "	119	71	48
11 "	124	71½	52½
11½ "	125	72½	52½
12 "	129	73	56
12½ P.M.	132	74	58
1 "	141	74½	66½
1½ "	140	75	65
2 "	143	75½	67½
2½ "	138	76	62
3 "	138	76½	61½
3½ "	132	77	55
4 "	124	76	48
4½ "	123	77	46
5 "	112	76	36
5½ "	106	75	31
6 "	100	73	27
Means ...	124½	73½	51¼

It will be observed from the above, that the highest temperature in the shade occurred between three and half-past four P.M.; but the power of the sun's rays was greatest between one and two P.M. Although the observations were only taken for one day, yet it was well selected for the purpose by one who is accounted a high authority in these matters. The ball of the thermometer which he employed for indicating the power of the sun's rays, was covered with black wool. As trustworthy observations of this nature are important to the subject in hand, the following additional extract is given from the same work:—

"The mean results of five series of experiments, conducted with every possible precaution, are contained in the following table, showing the power of the sun's radiation from half-past nine A.M. to half-past six P.M., in the month of June:—

Progress of Solar Radiation from Morning to Evening, in June, upon an average of five experiments.

Time.	Force of Sun's Rays.
9 $\frac{1}{2}$ A.M.	32°
10 $\frac{1}{2}$ "	46
11 $\frac{1}{2}$ "	55
12 $\frac{1}{2}$ "	63
1 $\frac{1}{2}$ P.M.	65
2 $\frac{1}{2}$ "	63
3 $\frac{1}{2}$ "	58
4 $\frac{1}{2}$ "	49
5 $\frac{1}{2}$ "	35
7 $\frac{1}{2}$ "	29

Here it will be observed, that the force of the sun's rays at half-past nine A.M. is, on the average, 32°, and that it increases between one and two P.M. to its maximum, 65°, or to rather more than the double of what it was at half-past nine A.M. It will also be seen, that it increases rapidly between the hours half-past nine, half-past ten, half-past eleven, and half-past twelve; and then during the next two hours the force is nearly uniform.

Moreover, the average force of the sun's rays in the three hours before twelve noon, is, according to these observations, about 44°; and in the three hours after twelve it is 62°. From this it is evident that a wall with a west aspect must be much warmer than one with an east aspect. The sun shines in a clear day as long on the one as on the other, but not with equal intensity. For three hours before noon, the sun shines on the east aspect at the same mean angle as he does on the west aspect for three hours after noon; but during the latter period his rays have, according to the above observations, about 40 per cent. greater intensity. The wall with the west aspect must therefore become much more heated than one with the east aspect. After half-past three P.M., the power of the sun's rays begins to decline considerably, but as some compensation for this they impinge more directly.

The southern aspect, being the most important, requires to be taken first into consideration. It may, according to circumstances, face either directly south; or it may be inclined to the south-east, so as to face the sun about eleven A.M.; or it may incline to the south-west, to face the sun about one P.M. In parts of the kingdom where the climate is sufficient to ripen peaches and nectarines per-

fectly, on a wall facing the sun at eleven A.M., that aspect should be chosen, as in that case the adjoining walls can proceed at right angles and afford two good western aspects, on which the sun may commence to shine as early as eleven A.M., so that apricots, plums, cherries, and the finest sorts of pears, could be ripened to perfection upon it. But, if the heat against an aspect thus inclined an hour to the east of the meridian is not sufficiently intense to ripen peaches satisfactorily, the aspect must face the sun at noon; and where the climate is still colder, it will be advisable to turn the aspect directly to the sun at one P.M.

With regard to the aspects of the other walls, it would not be desirable that each should receive an equal amount of sun-heat in the course of the day; for if this were the case, the consequence would probably be, that although many of the finer kinds of pears, &c., could be grown on both sides of the wall, yet none of the fruit would ripen to perfection. No comparison can be made between the real value of any quantity of partially ripened pears, and of half that quantity brought to full perfection. We should therefore endeavour to provide an aspect that will insure good flavour in those desirable fruits. The eastern aspect must be planted with such things as are most suitable, chiefly summer or early autumn fruits; for, owing to the ripening period of these being nearly that at which the hottest weather occurs, an indifferent aspect will ripen them tolerably well. Next, therefore, to the southern aspect, one that will be as little as possible inferior to it demands attention. It is desirable that the walls should be at right angles to each other. Where the southern aspect wall faces the sun at eleven A.M., the western aspect, if at right angles to it, will have the sun, as already observed, from eleven in the forenoon, and would then be inclined to the south of west as much as will insure the ripening of the fruits required to be produced against that wall. Where the wall on the north side runs from east to west, and of course faces directly south, the walls joining it may run north and south, but then the west aspect will have an hour less sun than in the preceding case, and consequently some things that would require that hour of additional sun, could not be properly grown against it, and they would need to be planted against the south wall, which, there-

fore, would have to be extended to afford space for them.

Where the southern aspect must be inclined to the sun at one P.M., if the walls joining it proceeded at right angles to it, the western aspects would be shaded till one P.M., and consequently would be rendered so much inferior, as to be unfit for the purpose of ripening such fruits as ought to have, as far as possible, an aspect provided for them little inferior to that of a south wall. This can only be obviated by giving the walls on the eastern and western sides such a direction, as to present western aspects that will receive the sun's rays as early as eleven A.M., although, by so doing, these walls will not join the others at right angles. The garden will then assume the form of a rhombus (Fig. 99), or that of a rhomboid (Fig. 100). This is somewhat inconvenient in working the ground, and dividing it for crops; but the latter will grow equally well, whilst a great advantage will be derived in regard to the ripening of fruits. The opposite sides of these figures being parallel, all the borders, beds, and quarters in the garden, can also have parallel sides; and this being the case, although their ends do not square

off, yet they are more easily worked than if the ground were wider at one end than the other, which must be the case where the opposite walls are not parallel.

From the foregoing statements it appears, that the walls of a fruit and kitchen garden should have the following directions, according to the climate of the locality:—

1. In the warm parts of Britain, the wall on the north side should face the sun at eleven A.M., and the walls on the east and west sides should run parallel to each other, and proceed at right angles from the wall on the north side.

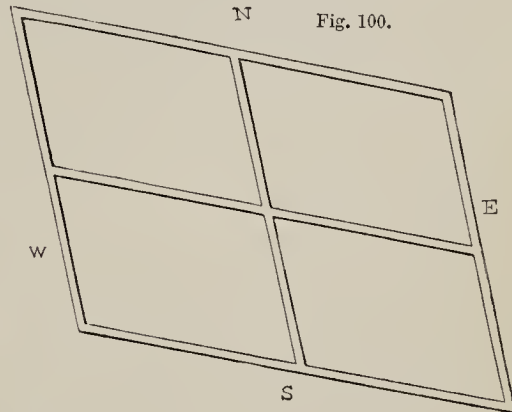
2. Where the climate is not quite so good, the wall on the north side may face direct south, with east and west walls at right angles to it, and consequently running in the direction of the meridian; but if the south wall is of limited extent, the other two may in that case run in the direction of the sun at eleven A.M., as in Fig. 99.

3. In places where the hottest aspect is necessary to ripen the peach and nectarine, the wall on the northern side may be made to face the sun at one P.M.; and the walls on the eastern and western sides should then run in

N Fig. 99.



N Fig. 100.



Position of Kitchen-Garden Walls.

the direction of a point in the horizon, above which the sun is perpendicular at eleven A.M., as in Fig. 100.

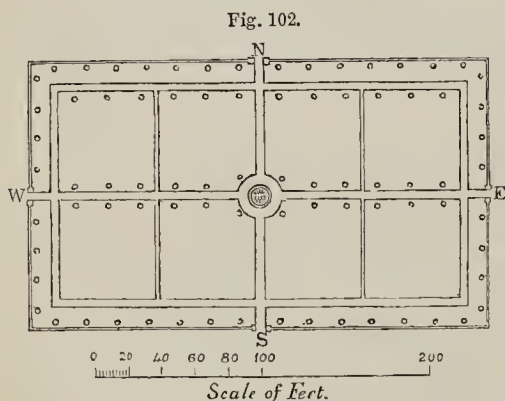
Where the peach succeeds well on the open wall, the position of the walls may be as in the first case. Where rather colder, the aspects pointed out in the second case may be adopted; and in the northern parts of Britain, the direction of the walls as given in the third case, would be most proper. Where the situation is too cold or northerly for the cultivation of peaches and nectarines on the open

wall being successfully attempted, the southern aspect should be occupied with apricots, plums, cherries, and pears. It is certainly not absolutely necessary that the southern aspect walls should face or be exactly at right angles to the sun's rays at the hours mentioned, nor that the eastern and western walls should follow to a minute the direction of the hour-lines. Nevertheless, the indication of the hour-lines will be a convenient guide, and they may be easily found with sufficient accuracy by a well-regulated clock or

From this it appears that the inclosure of a single acre, according to the above estimate, costs £552; but when 6 acres are inclosed together, the amount is £1350, or at the rate of only £225 for each acre inclosed. It will be evident, from what has been stated, that where it is an object to inclose a certain area with the least extent of wall, the garden, presuming that it is to be four-sided, must be in the form of a square. If, on the contrary, the object is to have a large extent of wall in proportion to the area inclosed, then the garden must deviate accordingly from the square, and be made to assume the form of a rhombus, the sides being equal, of a rhomboid, an oblong figure with the ends oblique, or of a parallelogram.

The southern aspect is so advantageous for the ripening of fruit, that it ought to be kept chiefly in view in forming a garden. In bad seasons, other aspects may fail in bringing fruits to perfection; in such seasons, well-ripened fruit is more especially valuable, and the best chance of obtaining it then, is from a southern aspect. On this account, it would be desirable that the garden should be of a form which would afford a greater extent of wall with this than any other aspect.

The form may, therefore, be that of a parallelogram, of which the length is as five to three. Fig. 102 is very nearly in this proportion,



and represents a small garden, $272\frac{1}{4}$ feet from east to west, and 160 feet from north to south; consequently it contains exactly an acre. On referring to the figure, it will be observed, that it admits of nearly double the number of trees on the south aspect, as compared with each of the others; and it allows a greater extent of espaliers to face the south, which is also important, as the fruit is more fully exposed to the sun throughout the hottest period of the

day, than it is in espaliers running north and south. Moreover, the figure admits of being divided into eight principal compartments, each of which forms nearly a square, after allowing for the space occupied by espaliers. Although it is not absolutely necessary to adopt exactly the above proportion of five in length to three in breadth, yet it will be found well suited for the convenient working of the ground, and for the ripening of fruits on walls and espaliers. The main area of the royal gardens at Frogmore is nearly in the above proportions, being 760 feet from east to west, and 440 feet from north to south.

Where there is scope for laying out a fruit and kitchen garden in any way that may be thought proper, the best form, in our opinion, for the reasons previously stated, is an oblong, which may either have the ends square or inclined so as to present aspects facing between south-west and west, according to climate. But if circumstances render it necessary to limit the garden to a square, or nearly so, then a good aspect for the eastern and western walls is more especially necessary, owing to the comparatively limited extent of south wall, and the rhombus form should, therefore, be adopted, if possible.

Various other forms differing from the above have been recommended, as well as a different direction of the walls. Most authors, however, agree, that a square or parallelogram is the most convenient; but they differ as regards the direction of the walls, and as to whether the length of the garden should be east and west, or north and south. Some recommend the walls on the eastern and western sides to face directly east, or between east and south-east, in order to have sun for a longer period during the early part of the day; we have already stated our reasons for differing from this. Others make the length of the garden run north and south, in order to have comparatively little extent of north aspect. As already explained, we however prefer to have a considerable extent of aspect decidedly good, rather than a small extent possessing this character, together with a large proportion indifferent in that respect.

The *extent* depends on various circumstances. It should be in proportion to the capacity of the mansion, so as to afford sufficient fruit and vegetables for the number of inhabitants which this is adapted to contain. A garden, even on a small scale, in the country, should not

be less than an acre. This is calculated to afford a moderate supply for 16 persons; but much depends on the nature of the soil, and on the kinds of vegetables in demand. In many cases, such things as turnips, potatoes, main crops of pease and beans, are now grown in fields for family use, so that the garden does not require to be so large as where it has to afford the whole supply. Again, the slips outside the garden may be of considerable extent; or, on account of boundaries, or of arrangements connected with pleasure grounds, the slips may be necessarily limited on one or more sides. These circumstances will accordingly require to be taken into consideration when determining the extent of area to be inclosed by walls. In the colder parts of the country, and especially where the situation is rather high and exposed to cold winds, the garden ought to be larger, shelter being, under these circumstances, required for many productions, which, in milder climates, could be grown outside. If there be an orchard to supply the hardier fruits, the garden may be less than where fruits will scarcely grow except on walls.

By a system of close and simultaneous cropping, a large quantity of vegetables may be grown in a comparatively small space. Vegetables, however, when so raised, are not generally so good as when the different crops have plenty of room. Abundance of space is better than too little; for if, at any time, the whole should not be required for kitchen crops, the spare ground may be cropped with potatoes, turnips, mangold-wurzel, or any other crop that may be found most profitable; or a portion may be occasionally laid down in grass, which will refresh it for the growth of vegetables again. At all events, the ground need not be lost, however much more it may be than is absolutely necessary for a supply. Where ground is at command, the question of size depends greatly on the expenditure that can be allowed for walls, a tolerably correct idea of the expense of which may be formed from the relative amounts which we have already given for inclosing from 1 to 6 acres. Less than 1 acre would be inclosed at a very great expense for wall in proportion to the ground, 6 acres is as much as will be required for a very large establishment; and in general, a fruit and kitchen garden of 4 acres will be sufficient to supply all ordinary demands.

IV.—SHELTER.

In treating of the most desirable site for a garden, that affording natural shelter was recommended to be taken advantage of, where it could be done consistently with other arrangements also necessary to be kept in view. But where the natural disposition of the surface affords little or no shelter, recourse must be had to artificial means of supplying it. Walls, it is true, afford a certain amount of shelter for the interior of the garden, and by receiving heat from the sun's rays, and radiating it again, a warmer atmosphere is generated within the garden than that without. But it is often the case, especially in our unsettled springs, that, after the sun has heated the interior of the garden during a comparatively calm period of the day, and when the motion of the sap has been stimulated in consequence, strong gusts of cold wind sweep through the garden, and by their mechanical force easily displace the warmer and lighter air. Walls afford good shelter so long as there is but little wind, and that steady; but when it is otherwise, it eddies round the inside of the walls, and if cold, it produces far more injurious effects on the vegetation which it there meets, than it does on that which is entirely in the open ground, and not subjected to temporary excitements. It is, therefore, of great importance that the progress which vegetation makes in a garden should be as much protected as possible from sudden checks; and this protection must consist in moderating the sudden effects of cold winds. This must be done artificially, and chiefly by means of plantations. These must be made on the north, north-west, and north-east sides; for the winds from these quarters are the coldest. The shelter to the north and north-east of the garden should approach it the nearest; for of all others these winds are the most to be dreaded. The nearer the sheltering objects are to vegetation, the greater will be the obscured portion of the sky, and the less the amount of light which the plants will receive. But what is grown on the north and north-east aspects is of little importance compared with the subjects on the other aspects; so that the shelter of the latter is more to be considered than the partial loss of light to the former. But the trees for shelter on the west and east sides should be farther removed from the garden walls. Along the north side

the screen may be as near as 60 feet, depending partly on the kind of trees employed; and about the same distance the screen may turn round the north-east and north-west corners, but should then gradually recede, leaving the garden quite open to the south-east, south, and south-west. After turning the north-west and north-east angles, the latter being especially guarded, the shelter, instead of being a continuous belt or avenue, may consist of clumps at considerable intervals, having on one side a general direction to the south-east, and on the other to the south-west, with other clumps farther off, and opposite the intervals.

The trees employed for shelter should, of course, be tall and quick growing sorts. In these respect, perhaps none excels the black Italian poplar (*Populus monilifera*). It will attain the height of 40 feet in a few years, especially if the ground is well trenched and manured previous to planting, and afterwards kept hoed and loosened on the surface when the trees are young. The larch and sycamore are also quick growers, the same may be said of the lime (*Tilia europæa*), and it may be pruned and trained so as to form a close screen from the ground upwards. The elm and beech ultimately become lofty, but their growth is slower than that of the others above-named; and where the soil is suitable, the Norway spruce (*Abies excelsa*), the Scotch fir (*Pinus sylvestris*), and the Corsican pine (*Pinus Laricio*), will also answer the purpose exceedingly well.

The trees may be planted so as to form an avenue; and if this has a double row of trees on each side, the force of the wind will be more effectually broken. In case an avenue should not be required, a belt not less than 50 feet wide may be planted with two sorts of trees suitable for the purpose. The poplar may be one of the sorts, and it should be planted near the side of the belt next the garden, and some slower-growing kind of tree behind it, elm or beech for instance, according to the nature of the soil. The poplar will afford shelter by its rapid growth in the first place, and if its appearance is not liked, the trees may be cut down when the other kinds are high enough to afford shelter. If some outposts in the shape of oval clumps were established, the force of the wind would be considerably broken before it reached the belt or avenue above recommended. The ovals

would be most effective if arranged, with their longest side towards the garden, in two series, and they may be at the distance of 200 or 300 yards. The clear distance between the ovals in each series should be equal to their length, and the intervals so formed should be covered by the ovals in the second rank or series. In passing through these oval clumps, the velocity of one portion of the wind will tend to neutralize that of another; for a portion of the air sweeping round an end of one of the outer ovals, will be partly checked by another portion sweeping round an end of the adjacent oval. If their forces should coalesce to a considerable extent, and the wind proceed in a direct course after squeezing through between the exterior clumps, it will again have to encounter the body of the clumps placed on the inside opposite the intervals of the others, and afterwards, with a generally broken-up, indirect, and diminished force, the wind has to encounter the regular belt or avenue.

As a means of preventing the wind from sweeping along the external surfaces of the walls, diagonal projections at each corner have been recommended; and there is an example of such in the gardens of the Earl of Rosberry at Dalmeny Park. Supposing the walls of the garden to run from east to west and from north to south, it is evident that a piece of diagonal wall extending, say in a north-west direction, will protect the western wall and border, when the wind is blowing from the north; but if the wind should be from the point north-west by west, it will strike at an acute angle against the diagonal projection, and will, consequently, act with collected force in the angle, and will then commence to sweep along the west aspect. When the wind from the north, or from any point between that and north-west, is prevented by a diagonal projection from acting against the western aspect, it will in that case be diverted with greater force against the northern aspect. Similar objections apply to a diagonal wall extending in a north-east direction. Instead of a diagonal projection at each corner, it would be better to extend the wall on the north side of the garden beyond the eastern and western walls as far as the breadth of the respective borders, or even to the outside of the slip. By this means, also, an additional length of wall with a southern aspect will be secured. If the walls cannot be so extended, a good close hedge may be reared.

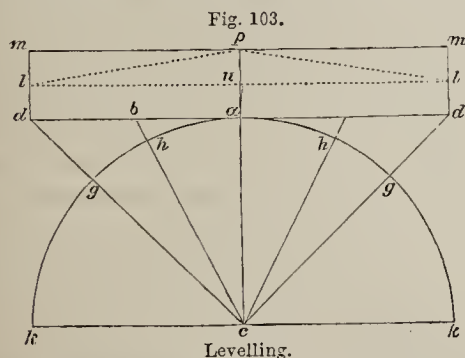
CHAPTER IX.

FORMATION OF THE FRUIT AND KITCHEN GARDEN—*Continued.*

I.—LEVELLING THE GROUND.

After the situation and outline of the fruit and kitchen garden have been decided upon, the next step is to determine the level of the ground or the slope thereof, as the case may be. Walls cannot be built to any required height above the surface of the soil until the height of that surface is known. If the ground is apparently level, still it is necessary to determine whether it is really so or not; and if found irregular, the height of the plane which it will present, when the irregularities of surface shall have been levelled, is necessary to be ascertained. If this be done with sufficient accuracy, a proper starting point for the elevation of walls or other structures, the height of the surface of walks, the depth of drains, &c., will have been obtained. Here, it is evident that some knowledge of levelling is necessary; and as much expense has been too frequently incurred for want of such knowledge, some plain practical directions on the subject, as connected with gardening operations, may prove useful, and lead to better results, with less expense than is usually the case when the operation of levelling the ground is commenced at random, and carried on almost by chance.

Supposing a plumb-line to be suspended from *p* (Fig. 103), it is evident that it would



hang in the direction of the line *pc*, or towards the centre of the earth. Any line crossing this at right angles, as *ad*, is generally termed a horizontal or level line, the line of sight, or the apparent level. But, supposing the line *kk* to represent the half of the globe, then

the circular line *kk*, parallel to the circumference, would be the true level, and so would *ag*, the straight line *ad* being only the apparent level, or horizontal line of sight. The surface of still water is considered to be a perfect level; it appears so to the eye, nevertheless it corresponds with the curve of the earth. If a canal were cut from *a* to *g*, the surface of the water with which it might be filled would form a curve like that connecting these two points. In short, if the point *c* represent the centre of the earth, and *a* a point on the surface, the circumference of the circle described by *ac* as a radius, would coincide with the true level, whilst the straight line *ad* would be the tangent to it, and would represent the apparent level. For a short distance, the difference between the true and apparent levels is inappreciable; but it goes on increasing in proportion to the square of the distance; for it is equal to the square of the distance between the station where the instrument is placed and the spot where the rod stands, against which the horizontal line of sight is directed, divided by the diameter of the earth. Thus, if the instrument is placed at *a*, and the distance from *a* to *h* be 1000 yards, *ab* will be the horizontal line of sight, or apparent level, and *bh* the difference between it and the true level, which difference can be found as follows:—First, squaring the distance, we have $1000 \times 1000 = 1,000,000$; this, divided by the diameter of the earth, which is about 13,924,000 yards, gives as a quotient .0718 yard, or .2154 foot, which is about 2.58 inches, or a little more than $2\frac{1}{2}$ inches; and this is the difference of level on a distance of 1000 yards. Therefore, if we multiply the square of the distance in yards by 2.58, and divide by 1,000,000, or, what is the same, multiply by 258 and point off eight places on the right, the difference of level will be represented in inches by the figures on the left, whilst those on the right will be decimals of an inch.

Although it will very rarely be necessary to apply the correction for garden purposes, yet cases may occur where it would be of essential importance. For instance, if two reservoirs were to be built, one in the garden, and another at a mile distant to supply the former; and if both were carried up to the same apparent level, the garden one would either not be filled to within 8 inches of its coping, or it would require to be built 8 inches higher

to prevent its overflowing, according as the apparent level had been taken from the supplying reservoir, or the contrary.

The following table shows the height of the apparent above the true level for every 100 yards, and also for every mile:—

Yards.	Inches.	Miles.	Feet.	Inches.
50	0.00006	0 $\frac{1}{4}$	0	0 $\frac{1}{2}$
100	0.026	0 $\frac{1}{2}$	0	2
200	0.103	0 $\frac{3}{4}$	0	4 $\frac{1}{2}$
300	0.232	1	0	8
400	0.413	2	2	8
500	0.645	3	6	0
600	0.928	4	10	8
700	1.264	5	16	8
800	1.651	6	24	0
900	2.089	7	32	8
1,000	2.584	8	42	8
1,100	3.121	9	54	0
1,200	3.715	10	66	8
1,300	4.360	11	80	8
1,400	5.056	12	96	0
1,500	5.805	13	112	9
1,600	6.604	14	130	9
1,700	7.446	15	149	11

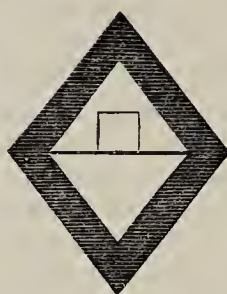
From the above table it will be seen, that the difference at the distance of 50 yards is almost nothing; therefore, if the levelling staves are placed 100 yards apart, and the instrument half way between them, no correction will be required.

It is scarcely to be supposed that a gardener can command an instrument, so nicely adjusted that the line of sight will be perfectly horizontal when the bubble is in the middle of the tube. Its line of sight may direct to a point too high or too low, but by placing the instrument exactly in the middle, as at *p* (Fig. 103), any error arising from the above cause may be avoided. If the instrument at *p*, when the bubble is in the middle of the spirit tube, has its sights directed to *l*, say on the right, it is evident that that point is below the horizontal line; and when the instrument is turned round, it will point as much below the horizontal line at *l*, on the left. These two points *ll*, are both in the same horizontal line, although not in that of the instrument; for the distance being equal, the error is equal on both sides. It increases in proportion to the distance; therefore, if the instrument were not placed exactly in the middle, the two points *ll* would not be equi-distant from *m m*, and consequently the straight line between the two former would not be parallel to the horizontal line of sight. In all cases, therefore, where the instrument is not of the most per-

fect description, and particularly well adjusted, it should be placed half-way between the staves, on which points in a horizontal line are to be marked. It may be observed, that on viewing from *l* to *l*, the error of the instrument will be seen to be *pn*; by measuring that distance from *l* to *m*, and then adjusting the sights of the instrument so that they will direct to *m* whilst the bubble is in the middle of the spirit tube, a level may then be taken for a short distance without risk of any material error, even although the instrument should not be placed midway, which it may not be possible to do in some cases.

To level a line, as, for example, that intended for the edging of a walk. Prepare a lozenge-shaped piece of wood (Fig. 104) about six

Fig. 104.



inches broad; paint it white, with the exception of an inch all round the margin, which should be black; also, a strong black line across from angle to angle. A square hole cut on the upper side of the cross line, admits of anything against which it is placed, being

marked exactly at the height of that line. If the length of the edging intended to be levelled do not exceed 600 feet, let a rod be placed at each end, and the instrument half-way between these. Let an assistant hold the lozenge-shaped mark against the rod at one extremity of the line, whilst the person at the instrument directs him to slide it up or down, till the line across its centre coincides with the line of sight from the instrument when the bubble is in the middle of the spirit-tube. Mark the rod at the height of the cross line; and in the same way the rod at the other end of the walk. The two points so marked on the rods at each extremity are in the same horizontal line, like the points *m m*, or *ll*, in Fig. 103. The instrument may now be removed, and a rod put in its place. By placing the cross line of the lozenge-slide on one of the points to which the level was directed, and then viewing from the point at the other extremity, the rod placed in the middle can be marked at a point which will be in a horizontal line with the other two. There will then be three ascertained points on the same level; and by viewing between any two, as many more may be marked along the line as

may be found necessary. Thus, on the rods placed between the two extremities, a series of points may be marked, all of which shall be in the same horizontal line. By measuring down a uniform distance from each of these points, the horizontal line which they marked may be transferred to the ground, or to the height to which the edging is to be worked. If this height be determined at any place, then it is only necessary to measure down to it from the level point originally marked on the rod, and to the same distance below each of the level points the whole edging should be formed.

But instead of being level, the walk may be required to have a uniform slope, so that one end shall be, say 2 feet lower than the other. In this, and similar cases, find the horizontal level points at each end as before; then mark a foot higher than the level point at the one end, and a foot lower at the other, and thus there will be a difference of 2 feet between these new points, and a straight line from one to the other will have the required uniform slope.

If a border were to be made level across a piece of uneven ground, and so that neither more nor less soil shall be employed than that which is found within its limits, the following mode of proceeding may be adopted:—Place a rod at each end, and intermediately a number of rods at equal distances from each other. Place the instrument in the middle of the length of the border, but not exactly in the direct line between the rods placed at the extremities, in order that these may be seen without obstruction from the other rods. Mark on the end rods two points on the same level, as before directed; and likewise points on the same level on the other rods along the line. Now, as the ground was stated to be uneven, the level points will be at unequal heights above the surface, and the question is, to what uniform distance below them the surface, when levelled, will reach without having soil to wheel away as superfluous, or any to bring in to make up deficiencies. We shall suppose the number of rods placed along the line to be ten. Measure down from the level points to the surface of the ground. Then, from these perpendiculars, find the mean depth of the space between the horizontal line and the surface of the ground. This is not unfrequently supposed to be done by dividing the sum of the perpendiculars by

their number; but this is not quite correct; therefore, the following mode should be adopted:—To half the sum of the first and last perpendiculars add all the others, and divide the sum by their number, less 1; the quotient will be the mean depth of the space between the ground and horizontal line; and a line traced at that depth below the horizontal line will be the ground level to which, if the high parts are taken down, the soil from them will exactly fill the hollows. Suppose the distances from the ground to the level points marked on the ten rods as follows:—

	Ft.	Ins.
Rod 1,	4	6
„ 2,	3	6
„ 3,	3	0
„ 4,	2	6
„ 5,	3	0
„ 6,	4	6
„ 7,	5	0
„ 8,	4	3
„ 9,	4	0
„ 10,	2	6
Sum of first and last divided by 2,	3	6
Sum of the other depths,.....	29	9
Number of depths, less 1=9,	33	3
	3	8½

The sum of all the depths divided by their number would give an average of 3 feet 7½ inches, which is not far from the truth, because a considerable number of depths were taken. But supposing the number of perpendiculars had been only five, and that their lengths were respectively 4 feet 6 inches, 3 feet 6 inches, 4 feet, 2 feet 6 inches, 5 feet 6 inches; then their whole sum, 20 feet, divided by 5, their number, gives 4 feet; whereas the correct mean depth of the space is only 3 feet 9 inches, the error being 3 inches; but this would amount to an excess of 50 loads of earth in a border 300 feet in length, by 20 feet in breadth.

But cases may occur where the ground is so irregular that the rods at each extremity cannot be seen from the middle, and it may be required to find—

1. The difference of level between the points where the rod is placed at *a* and that at *g*.

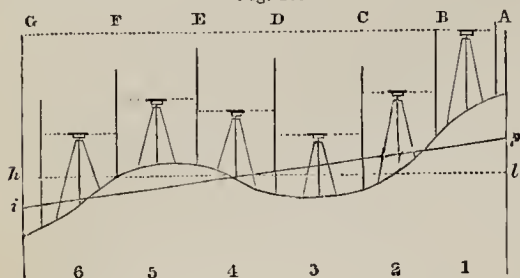
2. The height of a horizontal line, according to which the ground may be made perfectly level with its own soil.

3. The direction of a line, according to

which the surface will form a uniform slope, with the least possible movement of soil.

(1.) *To find the difference of level between the two extremities.*—Place the rods A, B, c, &c. (Fig. 105), at convenient distances, and so

Fig. 105.



that the surface of the ground will be straight, or nearly so, between every two. The operation may be commenced at either end; here we shall proceed from A. Place the instrument half-way between A and B, mark the level points on these two rods, and enter their heights from the ground in columns as under. Thus, after directing the instrument back to rod A, the line of sight is found to intersect that rod at 3 feet from the ground; write that height in the column headed Back-sight. Then turning the sights of the instrument, and viewing forward to rod B, mark the level, and enter its height from the ground, 5 feet, in the column headed Fore-sight. Move the instrument to station 2. Take there the back-sight level to B, and the fore-sight one to c, and enter the heights of these level points in the proper columns. Proceed thus till the levels are taken at all the stations: then sum up both columns; their difference is the difference of level. If the sum of the heights in the back-sight column be greater than that in the fore-sight one, the ground is rising; if the sum in the fore-sight column be the greater, the ground is falling, as is the case in the present instance.

Station.	Back-sight.	Fore-sight.	Distance of surface below horizontal line or datum, at	
	Ft. Ins.	Ft. Ins.	Ft.	Ins.
1,	A, 3 0	B, 5 0	A,	3 0
2,	B, 2 0	C, 5 6	B,	5 0
3,	C, 3 6	D, 3 6	C,	8 6
4,	D, 4 6	E, 3 0	D,	8 6
5,	E, 4 0	F, 4 6	E,	7 0
6,	F, 2 6	G, 5 6	F,	7 6
			G,	10 6
	19 6	27 0		
		19 6		
	Difference of level,...		7	6

From the above it appears, that the sum of the back-sight column is 19 feet 6 inches, whilst that of the fore-sight one is 27 feet; and that their difference, 7 feet 6 inches, is the difference of level between the surface of the ground at A, and that at G. On looking at the figure, it will be observed that the surface of the ground is undulating; but it falls more than it rises. By inspecting the entries in the back and fore-sight columns, it is found that, with the exception of the one at station 4, they are either equal, or those in the fore-sight column are greatest, and that the sum of the latter exceeds that of the back-sight column by 7 feet 6 inches; and, accordingly, it is found, as above explained, that the ground at G is that much *lower* than at A. If the work had been commenced at G, then the sum of the fore-sight column would have been least; and when this is the case, it should be recollected that the ground is *rising*.

The difference of level between the surface of the ground at A, and that at any of the rods, may be ascertained in a similar manner to that by which the difference between A and G has been found. For example, if the difference of level between A and E is required, the sums of the columns as far as E, are respectively 17 feet and 13 feet, the fore-sight column exceeds the other by 4 feet; and so much the surface of the ground at E is below that at A.

It will frequently be necessary, in practice, to know at any particular point the distance of the surface from the horizontal line adopted as a datum, such as the line A G. That distance, taken at each of the rods, should be entered in a column ruled for the purpose. It may be ascertained as follows:—For example, at E: at this rod we have just ascertained that the ground is 4 feet lower than it is at A; and the ground at A is 3 feet below the horizontal line A G; therefore, at E the surface is $4 + 3 = 7$ feet below the horizontal line. The distance from this line may also be readily found by summing up both columns, as far as the entry inclusive of the fore-sight on the rod where the height is required, omitting the initial height of the first back-sight. The difference of the sums is the distance of the ground from the horizontal line. Thus, at c the fore-sight column amounts to 10 feet 6 inches—the other, *omitting the initial 3*, is 2 feet; the difference, 8 feet 6 inches, is the distance of the ground from the horizontal line at c.

(2.) To find the height of a horizontal line *h l* (Fig. 105) according to which the ground may be made level with its own soil. Find the area of the perpendicular space between the surface of the ground and the horizontal line *A G*. Divide that area by the length of the horizontal line, and the quotient will be the distance from the line *A G* to a parallel horizontal line *h l*, according to which the ground will be level; for there will be as much of the solid ground above it as there are vacant spaces below it; so that when the heights are taken down to that line and turned into the hollows, the whole will be level. Supposing the rods are placed at the distance of 50 feet from each other, the areas of the spaces between each rod from the ground to the horizontal line *A G* should be found, in order to ascertain the area of the whole space. This can be done as follows:—

Perpendi- culars, {	A, 3 B, 5	B, 5·0 C, 8·5	C, 8·5 D, 8·5	D, 8·5 E, 7·0	E, 7·0 F, 7·5	F, 7·5 G, 10·5
Base,	8 50	13·5 50	17·0 50	15·5 50	14·5 50	18·0 50
÷ 2) 400	675	850	775	725	900	
Areas,	200	337·5	425	387·5	362·5	450

The total of these areas is 2162·5 square feet.

Now, the object is, to find where a horizontal line can be drawn that will leave as much space or hollow below it as there will be of ground above it, or that will form the end of a parallelogram, the length of which is *A G* = 300 feet, and which shall contain an area equal to that of the whole space above ground, up to the line *A G*, or 2162·5 square feet. If it do the one, it will certainly do the other; for a line that will include all the clear space above it, must exactly leave that which is, or ought to be made, solid ground below it. We may, therefore, divide the area of the space by the length, and it will give the breadth of the parallelogram, or average perpendicular distance from the datum line to the surface of the ground. The total area of the irregular space is, as above found, 2162·5 square feet, which, divided by 300, the length, gives 7·208 feet, or about 7 feet 2½ inches, and this distance measured down from the datum horizontal line *A G*, will determine the position of the required horizontal ground-line, *h l*.

In the above example, the rods are at equal distances, and this being the case, the mean distance from the datum line to the ground could be found by merely adding to the half sum of the first and last perpendiculars all the

others, and dividing this sum by the number of perpendiculars, less one; thus—

$$\frac{3 + 10·5 + 5 + 8·5 + 8·5 + 7 + 7·5}{2} = 43·25,$$

which, divided by 6, the number of perpendiculars, less 1, gives 7·208, or 7 feet 2½ inches, as before. But cases may occur where the rods, to give the correct area, must be placed at unequal distances, so as to be at the extremities of the different slopes, and then the mean perpendicular distance cannot be obtained by averaging the respective heights, but must be calculated by multiplying the sum of each pair of perpendiculars by the distance between them, and taking half the product for the area; or the sum of any pair of perpendiculars multiplied by half the distance, or half the sum of the perpendiculars by the whole distance between them, will, in either case, give the area of space included between the two perpendiculars. The rods, as before remarked, should be placed so as the surface of the ground will deviate little from a straight line between every two, or, in other words, at the highest and lowest parts of the surface.

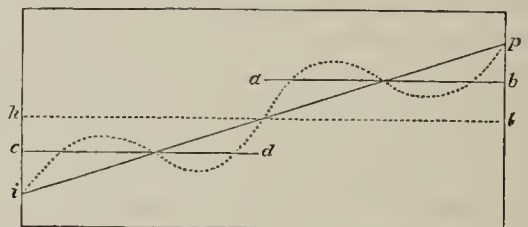
Thus, however irregular the surface may be, levels can be taken on the rods, so that the distance from the ground to a horizontal datum line can be found at any point, and, consequently, the area of the whole space, or section, between that line and the ground, can be ascertained. This area, divided by the whole base or distance between the rods placed at the extremities, will give the distance of the level ground line from the horizontal datum line. Here, it may be observed, that the centre of this ground-level remains at the same height although the ground may be laid to any slope. A border the length of the above line, 300 feet, may be perfectly level; and if three stakes, one at each end and one exactly in the middle, are driven in till their tops are level with the ground, as where the lines intersect the rod *D*, the ground may be laid sloping, by lowering one end below the level, and raising the other as much above it, so that the top of the stake at one end shall then be, say 1 foot above the ground, and the other a foot below it; still the top of the middle stake will be, as formerly, level with the surface, just as a plank supported at its middle between two fixed points may be placed horizontally, or more or less sloping, but the point at the centre will always retain the same position.

(3.) To find the direction of a line, according to which the surface will form a regularly inclined plane or uniform slope, with the least possible movement of soil. Instead of the ground being made perfectly level by the line hl (Fig. 105), let it be laid sloping with its own soil by a line ip . Place a rod at each extremity, A G , and one exactly in the middle at D . Find a line that will correspond with the horizontal level of the ground between A and D , and another for the space between D and G . These lines may be found in a similar manner to that by which the line hl was found. Here the total area of the spaces between A and D is $200 + 337.5 + 425 = 962.5$ square feet. This, divided by the length of base between A and D , 150 feet, gives about 6 feet 5 inches to be measured down from the datum line AG for the horizontal level of the upper half of the ground. The areas of the spaces between D and G are 387.5, 362.5, 450; and their sum, 1200, divided by 150, gives 8, the number of feet to be measured down from the line AG for the horizontal level of the lower half of the ground. This is 1 foot 7 inches below the level of the other half. The mean between these levels gives the position of the horizontal line hl of the whole piece. Now, it has been explained that, whether the surface is reduced to a horizontal level or whether it is laid sloping, the point in the middle of the horizontal ground line always retains the same position, the same distance from the datum line. AG , and it is always at the surface of the ground, whether this be level or formed with a uniform slope. Now the mean level of both the upper and the lower half of the ground has been ascertained, also the general level of the ground hl , and the central point at the intersection of the rod D , which point, it is certain, as above explained, must always be in the surface plane, whatever the inclination of this may be. On this point as a centre, the line hl may have one end elevated to any required extent, whilst the other is equally depressed; and still the ground will suffice to level itself to that slope. But the question is, how to determine the amount of slope, so as to have the least possible quantity of soil to move. This can be done by a line drawn through the centre of the mean higher and lower levels, and such line will also pass through the centre of the general level. The same will be effected by setting up the difference of height between

the higher and lower levels from l and down from h , marking the points ip , a straight line between which will give the direction of an inclined plane, requiring less moving of soil to form it than would be the case with any other; and at the same time the ground will not have to be moved to so great a depth in certain places as if a horizontal plane were formed. These are important objects; for with reference to Fig. 105, supposing the ground were to be reduced to a level, and that the portion of bank between A and B extended 200 feet, in that case 2670 cubic yards would have to be moved, partly into the adjoining hollow, and partly to the distance of upwards of 200 feet to the hollow between F and G . But by the slope, ascertained to be best, the removal of as much as 487 cubic yards is saved, as well as the distant carriage. If the ground were required to be taken down to the level, the depth to be cut down from the surface to l would be 4 feet $2\frac{1}{2}$ inches. At that depth solid rock might be met with; but by adopting a slope, the cutting would be reduced to 2 feet $7\frac{1}{2}$ inches.

Where the subsoil is as easily penetrated in one place as another, and where the surface has to be made of one uniform slope at the least expense, proceed in the following manner:—Find the mean levels of the upper and lower halves, as ab and cd (Fig. 106), and

Fig. 106.



Levelling.

the difference of their heights, ad , say 4 feet. Half the difference marks the position of hl , indicating the mean level of the whole piece. Measure up 4 feet from l to p , and down from h to i ; the line ip will correspond with a slope requiring a less amount of labour than any other to reduce the undulating surface, represented by the dotted line, to a uniform inclined plane. It will be observed that the rising ground opposite a , has only to be turned into the hollow at b , and the projection at c will suffice to make up the adjoining deficiencies near d ; and with these two simple operations the work is completed. If a steeper

slope were to be adopted, it is evident that a quantity of soil would have to be moved up-hill from near *i* towards *p*. If, on the contrary, the slope were to be made less than that represented in the figure, more than the minimum quantity of soil must be moved, although easier, of course, than in the other case, because down-hill.

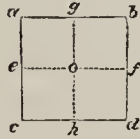
Hitherto the directions have been given for levelling a line, such as the edging of a walk or a strip like a border, which, although sloping irregularly in the direction of its length, was supposed to be all along horizontal across. If those directions are well understood, there will be less difficulty in comprehending a more complicated part of the subject, which must now be entered into.

If the ground undulates with a general slope in one direction, say from north to south, and if it does so regularly across the whole area, the instructions already given will be sufficient; but it may also slope irregularly in other directions, so that neither the perfect level nor the general uniform slope of the least expensive formation, can be so easily determined.

It is always desirable that the two upper corners of the ground should be on a level with each other; and the two lower corners should likewise be level, that is, in the same horizontal line. When ground undulating in various directions is to be made perfectly level, a strip or border might be so made along one side, and by working the entire area up to this, the whole would of course be level. But whilst endeavouring to do so, it may be found that the soil of the place becomes deficient, or, on the contrary, superabundant. This would lead to great inconvenience and expense, and would tend to spoil the ground. The model level, and as much of the surface as had been worked up to it, would have to be altered, and in doing this the ground would be liable to be puddled worse than in the first instance. Moreover, the substratum should be so regulated as to be a certain distance below the surface, namely, the estimated average thickness of the top-soil. The soil and subsoil may be worked accordingly, but both too high. By reducing the surface to the proper level, the depth of good soil, so far as the reduction goes, will be less than it ought to be, unless the substratum be also lowered. In order that such unsatisfactory and expensive labour may be saved, due care should be taken to

ascertain the proper average level of the whole ground. In order to do this, it is necessary to find at some convenient height a number of points in the same horizontal plane, so that from these the average depth of the space between that plane and the surface of the ground, can be ascertained. Place a rod at each corner, as *a*, *b*, *c*, *d* (Fig. 107), and tak-

Fig. 107.



ing care to place the instrument half-way between the rods, in case of error from the line of sight not being exactly parallel with the axis of the spirit tube, mark level points on the rods, say *a* and *b*, move the instrument to one of the adjacent sides, as between *b* and *d*, and mark similar points on each of them. Now, it will rarely happen that the marks on the rods taken from station *f*, will correspond with those taken at station *g*. The difference, however, whether higher or lower, will be seen on the rod *b*. If it be, say 10 inches lower, then mark 10 inches above the level point on the rod *d*, and this mark will correspond with the levels first taken between *a* and *b*. Proceed in the same manner with the levels between *d* *c* and *c* *a*, and thus four points, one at each corner of the ground, will be obtained in the same horizontal plane. If the ground is not very irregular, place rods at equal distances in line from end to end, and across, so as to form the whole into squares, and by viewing from the level points at the corners, as from *a* to *b*, mark others on the rods placed intermediately along that line, and likewise on the rods on the opposite side, between *c* and *d*; and by viewing between each pair of opposite rods on these sides, the whole of the rods can be marked to the same level. Then, by the preceding rules, find the mean perpendicular of the space between the ground and the horizontal line on the side *a* *b*. Mark this down; and in a similar manner, the mean of the next parallel line of stakes, and of all the other lines running in the same direction. Add the mean height of the line *a* *b* to that of *c* *d*, and to half the sum add the means of the heights of all the intermediate ones; divide the sum by the total number of rows or stakes, less 1, and the quotient will be the distance to be measured down from the level mark on each rod for the mean level of the ground. But if the ground is very irregular, divide it into a number of equal portions, either squares or parallelograms, by rods in

longitudinal and transverse lines, and after marking a uniform level point on each, find in each portion the mean distance of the surface of the ground from the said level, and divide the sum of these distances by their number for the general level of the whole ground. If the ground in each subdivision is tolerably even, that is to say, if there be no material height nor hollow between its opposite corners, the heights of the level marks on the rods at these being added, and divided by 4, will give the mean height of the surface. Where much irregularity of surface exists in any square or oblong subdivision, the latter may be subdivided into two or four, and the mean distance of each from the horizontal line being taken, the average of these will then be correctly enough the mean of the whole square or parallelogram so subdivided. In order to find the slope to which the whole irregular surface of a piece of ground can be most easily formed: divide the whole area into four portions, by lines intersecting at half the length and breadth. Find the mean level of each; then it will be seen which two adjacent quarters are highest, and from the latter it is evident the ground must slope towards the other two quarters. Add the two higher means, and halve the sum for the mean of the higher part of the ground; and in a like manner the two lower means, for the mean of the lower half of the ground. The mean of these will be the mean level of the whole area. The difference between the upper and lower levels, added to the mean height of the whole area, will be the height of the upper side of the ground; and the same difference subtracted from the general mean, will give the height of the lower side. By this the general inclination of the ground will be known; and whether it will be expedient to adopt that slope, or to modify it, can then be taken into consideration.

The ground may naturally slope in one direction, as from ab to cd , or it may slope in that way and likewise from ac to bd , or the contrary. It may slope, for example, from north to south and also from east to west, and thus its general slope will be south-west. When a piece of ground slopes only one way, say from ab to cd , both these sides are horizontal, although not on the same level; but when it slopes two ways, none of the sides is horizontal. It is always desirable that a garden, if it slope at all, should do so only in one

direction; but nevertheless it may be found expedient to adopt a slope in two directions; and in some cases, such as in lawns and shrubberies, this may be most desirable. Suppose the area, $abcd$, is found to slope from ab to cd , and likewise from bd to ac , divide the ground by a line ef , half-way between the sides ab and cd ; then, following the directions already given for finding the mean distance of the surface of a piece of ground, from any horizontal plane that may be most conveniently adopted, find, separately, the mean levels of the upper and lower portions ab , ef , and ef , cd . Add these two means together, and half the sum will be the mean level of the whole ground, and will be the distance of the surface from the horizontal line at the point o , the centre, but nowhere else when the ground is made to slope both ways. Mark this general mean distance on rods placed at g and h . Now, supposing the difference of the horizontal levels of the upper and lower halves of the ground to be 4 feet, measure *up* this distance from the mean level mark on the rod g , and *down* from that on the rod at h , and thus two new points will be obtained, a straight line between which will correspond with the slope of the ground in the direction of the middle line gh . It will be as well to drive stakes, so that their tops may be at the height of these points, and also one at o . The slope of the ground in one direction being thus ascertained, it yet remains to find the slope from bd to ac . Whatever that slope may be, three points in it are already fixed, being the height of the top of the stakes driven at f , o , and h ; and however much the ground falls from gh to ac , so much must it rise from gh to bd . This depends on the relative heights of the portions on each side of the line gh . Level horizontally from g to the rods a and b , and from h to c and d . The difference between the mean levels of the portions on each side of the line gh , being measured up from the points last marked on the rods bd , and down from those on ac , four points will be obtained, which will determine the slope that can be formed with the least movement of soil, and, consequently, in the best and most economical manner, being that which is best adapted to the general inclination of the ground.

In cases where the level of any of the sides is already determined, as where walls have been previously built, terraces formed, or

buildings erected, the general level of the ground must be ascertained, and marked at the central point *o*, and a line, as *ef*, drawn across it, parallel to the side on which the level has been previously determined, which suppose to be *ab*. Ascertain how much the level of *ab* differs from the mean level *ef*, if it be, say 2 feet higher than the latter, then the opposite side, *cd*, must be 2 feet lower than *ef*; but if *ab* be lower than the mean, *cd* must in that case be so much higher than *ef*.

After due consideration of the foregoing directions and examples, with a little practice any one may understand how to level sufficiently well for garden purposes. It may be objected by some, that they have no instrument at command by which the levels may be taken as we have directed. To this it may be replied, that a mason's common plummet level can always be obtained, and the levels can be carried on with it, from rod to rod, correctly enough, if proper care be taken, although not so expeditiously as by other means. But it is better that some time should be occupied, even by this tedious process, with a plummet level, than to commence operations, at random, judging merely by the eye; for this, where the ground is very irregular, often proves very deceptive. Workmen may be set to lower the parts that are obviously too high, and of course make up those which are evidently too low; but in doing this they cannot know how much the one part should be taken down, or how much the other should be raised. They may, however, contrive to bring a height and its adjoining hollow to a tolerably fair level; by successive lowerings the height is at last reduced, and a uniform surface appears instead of the original height and hollow. After due pains have been taken to smooth this portion, the next height and hollow can be treated in a similar manner; but when this is done, in all probability the two portions thus levelled will not agree; means must, therefore, be employed to make them do so. The carefully smoothed surface of the highest portion must be broken up; third and fourth portions can then be brought to a level with the two first; still it may be questionable whether all may not have to be altered, in order to agree with the remaining portions of the ground. This is as likely as not, for it is all chance work. One cannot go to work by chance with confidence; he is

always in danger of going too deep or too shallow, and of having to undo what he has done. He cannot tell, in fact, when or at what cost the work will be accomplished. It is very different when levels have been taken; the workman, in taking down a portion that is too high, knows by the marks on the adjoining rods how deep to go in lowering, and how high in making up, and he can then work freely without hesitation or fear of going wrong. If ground be only worked roughly to the level marks in the first instance, still it will be found that a digging will render the whole surface perfectly satisfactory. In short, it will be found that without knowing how to level, neither draining, trenching, nor other ground work, can be well, and at the same time economically performed. Having endeavoured to explain this subject so that there need be no difficulty, we may now enter upon that of draining.

II.—DRAINING.

We have treated at considerable length on the subject of levelling, because its importance, in many garden operations, renders a knowledge of it very desirable. We may now proceed with draining, an operation which should precede that of trenching and other ground work, but which ought not to be commenced until the level of the ground has been determined.

The beneficial effects of draining having been noticed under the improvement of soils, matters more immediately connected with its practical details have now to be taken into consideration.

The necessity of draining is naturally the first question; for it would only be a waste of money to drain a garden that is either naturally too dry, or one that, on examination, is found to possess no superfluous moisture. It is generally not difficult to decide at any time in the case of ground being too dry. Occasionally, however, the soil may be of a dry open nature, and yet prove in certain seasons too wet below for the roots of fruit trees. In this case the subsoil is usually of a very impervious nature, and lower than the high-water level of the channel which receives the drainage water of the site of the garden and its vicinity. The height to which the water channels rise after heavy rains, can be ascertained either from actual observation or

from water-worn marks; and by taking the level from these to the garden, the height to which the temporary stagnant water will rise can be known. If the water only rise too high occasionally after heavy rains—if the rise is only the exception and not the rule—the trees will thrive very well. But if it stand too high for a great part of the year, then it ought to be drained, if possible.

The site of a garden may be perfectly level, and at the same time naturally well drained. Where there is a good top-soil on a loamy sub-soil, and this again on gravel conducting to a considerably lower channel, no artificial drainage is requisite; for the worms perforate the stratum of loam, even if it should be 2 feet deep, to the gravel, and by this means the surface water readily passes down—sometimes, indeed, too readily; for under these circumstances, and where the mean temperature of the year is about 50°, and the annual amount of rain only 24 inches, fruit trees frequently suffer from dryness at the root; therefore, ground so situated, does not require drainage. Ground lying on a slope, but free from springs, may be too wet in certain parts, for where the slope is not regular, water is likely to collect in the hollows. But when the subsoil is reduced to a regular slope, these inequalities being removed, the rain water will not lodge in one place more than in another, and in all probability there will be no necessity for drainage. In short, where the subsoil has, either naturally or artificially, a regular slope, and where no water reaches it except that derived from the rain which falls on the area, draining will not be requisite except in climates where more than 30 inches of rain falls in the course of the year. With a uniform, and, it may be, only a slight descent to a lower level, a moderately porous soil, even in a wet climate, may not be in want of artificial drainage; and on the other hand, ground may be so circumstanced as to be absolutely unfit for crops until it be drained, although the annual quantity of rain may be comparatively little. Whether, therefore, a soil requires draining or not, depends, it would appear, not so much upon the quantity of rain which falls on the spot as on various other circumstances.

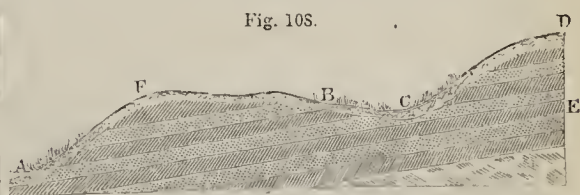
The great and constant source of moisture for the soil is the ocean. This supplies the land with an amount equal to that of all the water which the rivers discharge into the sea. By the action of the sun's rays, the water is

raised from the ocean in the form of vapour, which is condensed and falls in the shape of rain, or is deposited as dew on cold surfaces. It has, however, to find its way, directly or indirectly, back to that ocean from which it was raised by evaporation. Water, it is true, is raised from the surface of the earth, as well as from the ocean; but it is evident, that whatever is evaporated from the soil will be again absorbed by it. If from a certain portion of ground that on an average contains 100 gallons of water, nearly that quantity is evaporated during a period of drought so as to leave the soil almost completely dry, it is certain that the same portion will absorb 100 gallons when rain falls in sufficient quantity. If a country had no supply of rain from any source of evaporation except that from its own surface, one of two things must happen, either it can have no rivers, or if it have any, the country must get every year drier and drier so long as these rivers continue to run; and as the ground becomes progressively drier so the quantity of rain must become less and less every year, from the drier surface affording less evaporation. Now, in Britain, rivers have flowed to the sea for thousands of years and the ground is not thereby reduced to an arid state; therefore the rain which supplies these rivers must be derived from evaporation from the ocean, whilst, as previously stated, all the rain from local, or land evaporation, must, on the average, be re-absorbed by the soil. These islands have, then, a supply of moisture or rain from the ocean equal to the quantity of water discharged by all the rivers in the kingdom; and a quantity of moisture, equal to the amount of evaporation from all surfaces affording it, must be alternately in the state of aqueous vapour in the air and of moisture in the soil. With the exception of the comparatively small portion of surface presented by lakes, rivers, streams, or rivulets, all the water which flows to the ocean, must either percolate through the soil or run over its surface; and in addition to this, a portion of the rain, equal to that derived from the evaporation from the land surfaces, will partly rest on these surfaces, and partly enter the soil, till again evaporated. In this way, a certain amount of moisture may pass and repass several times through the soil in the course of a year. But where the ground is either level or forms a uniform slope, no drainage has to be provided for this moisture, as it is no more than can be evaporated.

From what has been stated, it is apparent that the total drainage of a country, natural and artificial, is equal to the quantity of water discharged into the sea. If we were to suppose that the soil, instead of being disposed in mountains and valleys, were laid on a uniformly sloping, impervious stratum, what, it may be asked, would be the consequence of such an arrangement? The whole of the moisture, except that kept up by evaporation, would drain regularly towards the sea; and if no river channels were formed, the soil of a large extent, comprising the lower part of the slope, would be continually in a state of saturation; for there would have to pass through it all the rain-water locally due to it, also that from the whole of the ground above it. The greater part would be unfit for cultivation until artificial channels, adequate to drain off the superfluous water, were formed. The general direction of these channels ought to be that of the slope, as is the case with natural rivers, which have, however, to wind amongst the irregularities of the ground, from having to find the lowest bed. But this winding would not be necessary in the case of a uniform slope, and the subsoil which we have supposed, and the most economical way to drain it, would be parallel channels in the direction of the slope, with lateral or branch channels diverging upwards from them at angles of 45° . Their number could be regulated, so as to leave the ground neither too wet nor too dry for vegetation. Natural slopes are not unfrequently to be met with which might be drained on the above principle.

The ground in this country being very irregular, the superfluous water is conveyed, as already observed, by rivers and streams. In some cases, these natural channels may require deepening, but in general they can be looked upon as affording sufficient fall for the drainage of the adjoining ground; and they accordingly answer the purpose of the parallel straight main channels in the supposed uniform slope of country, although not so speedily, from the circuitous route which they have to take. In the supposed case of the regular slope and uniformly impervious subsoil, a main channel would receive from each of its tributary ones a quantity of water equal to the amount of rain, less evaporation, which would fall on each intersected portion of the area. Presuming that the total quantity of rain was equally distributed over the whole surface, the branch

channels, at equal distances and of equal lengths, would each receive the same quantity of water; but it must not be supposed from this, that in reality, drains of equal length will all contribute equal quantities of water to the natural channels or rivulets. In the same locality, perhaps in the same field on which the fall of rain on one part cannot differ much from that on another, a drain may be cut of a certain length and draw but little water, perhaps a little after very heavy rains, or there may be none even then, if the soil is so deep as to absorb and retain the rain-water till it is evaporated. Another drain, similar to the preceding in every respect, may discharge ten times as much as the fall of rain on the portion of surface within range of its draught; and this it may do although the field be so situated as to derive no supply of water from the rain which falls on any part of the ground immediately surrounding it. It has been explained that all superfluous water must be derived from rain; but in the case we have supposed, similar, in fact, to many which are actually to be found, it may be asked whence so much more water than could be supplied by the fall of rain on the field, is discharged by one drain, whilst so little falls to the share of the adjoining one? As the excess could not be obtained from rain falling on the surface of the field itself, or conveyed to it by the surface of any adjoining slope, it evidently must have been derived from rain that has fallen on some distant part, whence it must have found its way to the drain in question by underground channels, such as strata of porous materials through which water can penetrate. Strata of this description are frequently to be met with, and generally form more or less inclined planes, sometimes of considerable extent. This will be readily understood by reference to the following diagram, in which the dark portions represent clay or other impervious strata, and the lighter gravel, sand, or chalk, permitting a passage to water. The narrow band A, F, B, C, D (Fig.



108), represents the surface layer. The rain which falls between B and D must flow to-

wards c, where, in sinking through the surface soil, it reaches the impervious stratum E, which arrests the passage of the water in a perpendicular direction, and it therefore passes along the pervious stratum, and crops out at A, where it either forms open springs and rivulets or a swamp, or, at all events, it keeps the surface soil saturated for the whole or greater part of the year. In this way, a part of a district at A may be injuriously affected by rain or melted snow falling at a great distance from it, as in the part of the country between B and D. Moreover, it will be understood that if a drain be cut in the pervious stratum, it will discharge a large quantity of water, compared with one that may happen to be cut, it may be said improperly, into the impervious one. Fig. 109 will serve to illustrate this; let the light lines represent thin porous layers through which water can percolate. If a drain

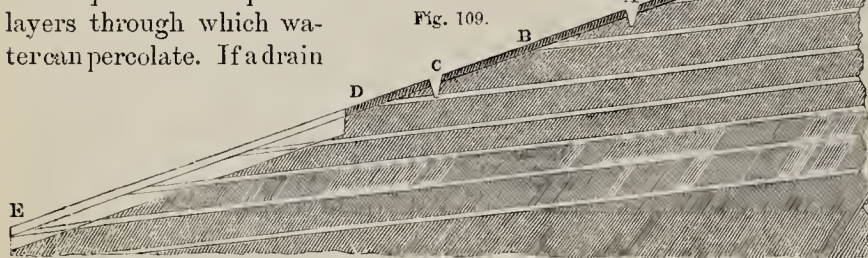
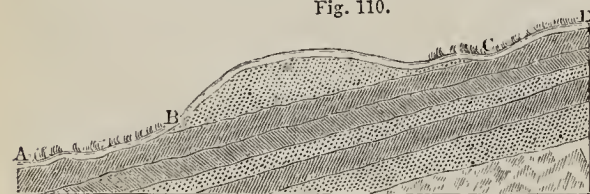


Fig. 110.



whereas the drain c reaches a part of them as it proceeds towards the surface at D.

Fig. 110 represents a tract of undulating ground, a large portion of which rests on a porous subsoil, as from B to c, whilst from A to B and c to D are marshy, from the rain which falls on these portions not escaping; and it will be observed, that the portion from A to B receives, also, the water which drains through the subsoil between B and c.

Occasionally the strata are disposed in the



Fig. 111.

form of a basin, as in Fig. 111. The rain

which falls at A and B percolates towards the centre, and the water may force its way through the thinner part of the mass of clay, as at D; by boring at c, an artesian well would be obtained. Fig. 112 also represents porous

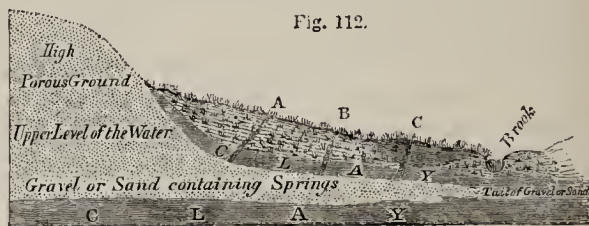


Fig. 112.

subsoil, in which the water is confined by layers of clay, except when it forces passages or springs from its pressure through the upper layer, as at A, B, C.

In some clay soils, a bed of sand or gravel, completely saturated with water, occurs at the depth of a few feet below the surface, with which it has corresponding undulations; but in places where its water is subjected to the greatest pressure, and the stratum of clay above it offers the least resistance, springs from it appear at the surface, or it saturates the soil so as to render it only fit for subaquatic vegetation. Fig. 113 exhibits this arrangement of strata, where A represents the surface soil; B, the impervious clayey subsoil; c, the watery stratum of sandy clay or gravel; and D, the lower bed of clay resting upon the rocky strata; E and F springs. Supposing the lowest portion of the stratum c, or that between E and F, is to be 4 feet lower than the



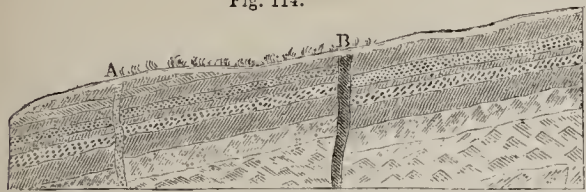
Fig. 113.

highest part of the curve on each side of it, then when the whole is completely saturated, the upward pressure between E and F will be equal to 250 lbs. on the square foot.

Some rocky strata, impervious to water, are interrupted by fissures, as represented at A B (Fig. 114), which are called *faults* by miners. Some of these fissures are occupied by substances which obstruct the passage of

water, others with those of a porous nature. Let A represent a sandy stratum, B a clay one,

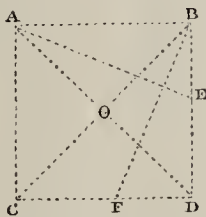
Fig. 114.



and C and D porous strata charged with water; on reaching the fault at B, the water will collect, and rising upwards so as to form a spring at the surface, it will render the soil between B and A too wet. The water, however, on reaching the sandy fault at A, will pass down through it to the porous strata, which, before the disruptions at A and B, had been continuations of the strata C, D.

From the preceding diagrams, it will be observed that the strata are sometimes as irregular as the surface, but this is not generally the case. On the contrary, they mostly form inclined planes, so that when we once get trace of a watery stratum, and can ascertain the ratio of its slope, its depth from the surface at any point so far as it extends, and the place where it crops out to the surface, can be pretty well determined. We must endeavour, in the first place, to find, as nearly as possible, the direction of the greatest slope or inclination of the stratum. This may be done by digging down to it in three places, as at A, B, D (Fig. 115), their position being such as to form two sides of a square.

Fig. 115.



Then find the relative levels of watery strata at these three points. If D be the lowest, and A and B be on the same level, the slope of the stratum is direct from A B to C D. If B is the highest, and A and D equally lower, the greatest slope will be from B to C, crossing the diagonal at right angles in o. If B is the highest, A the next lower, and D the lowest, then the line of greatest slope will be through some point between o and D. To find this point, divide the line A D, in proportion to the slopes of A B and B D. Let that of the former be 8 inches, and that of the latter 20 inches. The line A D, $226\frac{1}{4}$ feet, or nearly so, in length, divided in the proportion of 8 to 20, gives 64 feet 7 inches as the less, and 161 ft. 7 inches as the greater portion. It is evident that the greatest fall will be nearer D than A; therefore the greater

proportion set off from A to D, or the less from D to A, will mark the point through which the line of greatest slope, B F, intersects the line A D. Or, as the difference of level between B and D is to the distance between these points, so is the difference of level between A and B to the distance from B towards D, where the stratum will be at the same level as at A. Stretch a line from A to the point

thus ascertained between B and D, and a line across it anywhere at right angles, will indicate the direction of the greatest inclination of the stratum. Suppose that from B to A the slope is 8 inches, and from B to D 20 inches, and that the side of the square from B to D is 160 feet; then as 20 in. : 8 in. :: 160 ft. : 64 ft. At the distance, then, of 64 feet from B to E, the stratum will have declined 8 inches, or as much as from B to A; consequently, A and B will be on exactly the same level, and a line drawn between them will be at right angles to the line of greatest declivity. Accordingly, a line B F, stretched from B and across A E at right angles, will indicate the greatest inclination along this line. The depth of the strata below B should be ascertained at two or three places, say 50, 100, 200 feet or yards apart, noting at each place the depth of the stratum below that at B, in order to know the ratio of its slope per 100 feet or yards. If it slope, for instance, 6 inches in 100 feet, it is easy to find the amount for 1000, or any other number, so that at any point the depth below the starting point, as B in this case, can be calculated. By the directions already given for levelling, the relation which the surface at any place bears to the starting point at B, whether higher or lower, can easily be known. To ascertain the depth of the stratum below the surface of the ground at any point, say 800 feet from B:— Find the depth of the stratum at that distance, which, presuming that it slopes 6 inches in 100 feet, would be 4 feet; also, how much the surface at that distance is higher or lower than the surface at B; and let it be supposed that at the latter it is 3 feet above the stratum. If at the distance of 800 feet, the surface is found to be 4 feet lower than at B, then it will have sloped just as much as the stratum, and of course will be, as at the origin of the investigation, 3 feet above it. If on the same level as at B, then the stratum having, in the interval, sloped 4 feet, will be 7 feet from the surface; and if the latter is

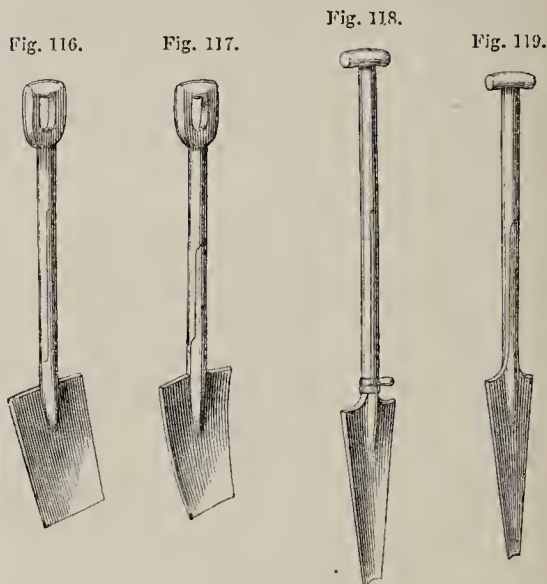
2 feet higher than at B, it will be 9 feet from the stratum. If, on the contrary, the surface of the ground fall as much as 7 feet, it will meet the course of the stratum, which will then, as it is termed, *crop out*, as is the case with the porous stratum c (Fig. 108), after passing under the elevated ground which intervenes between c and A.

Spring water, conveyed to a distance through such porous channels as those to which we have endeavoured to direct attention, cannot be too much guarded against. Secluded from the influence of the sun's rays, or of warm air, it acquires in the bosom of the earth the temperature of the latter, which at a certain distance from the surface, differs little from the mean of the climate, from 46° to 49° in these latitudes. This temperature it communicates to the soil, rendering the latter not only wet, but too cold in summer for most kinds of garden plants. A slope may face the south, and the sun's rays may exert their influence in warming vegetation above the surface; but this will be to little purpose, whilst the roots are constantly chilled with an unfailing supply of cold spring water. In spring, the temperature of well-drained land, in some situations, is probably not higher than that of spring water; but as the season advances, and the atmospheric temperature rises, so, in a nearly equal ratio, does that of the soil. But where affected by springs, the temperature of the soil does not rise in accordance with the increasing summer heat, and consequently, in such soils, a great discrepancy must take place between the temperature to which the roots of plants are subjected, and that to which their tops are exposed; and under such conditions vegetation cannot prosper. Referring again to Fig. 108, the rain, in descending the slope from F towards A, will probably be colder in winter; but when the plants are in active vegetation in summer, and requiring the most warmth at the roots, the moisture along the surface from F, being immediately derived from summer rains, and passing over or percolating through the heated surface-soil, will, as regards heat, prove highly favourable to vegetation. It is, therefore, the chilling effects of cold spring water, derived from distant sources through porous underground channels, that ought to be most especially guarded against; and the most effectual means should be taken to render the soil and subsoil of the garden free from them. It is with this view

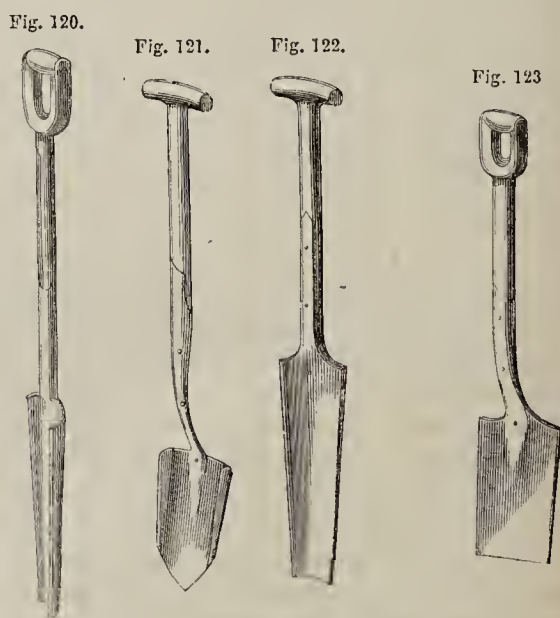
that we have been more minute in details respecting the direction of strata, than some may consider necessary in treating of gardening operations.

Before entering upon the formation of drains, it will be necessary to describe the different kinds of tools required for the purpose.

Spades of different widths are required, such as are represented in Figs. 116, 117, 118: the latter, and also 119, are called bottoming tools.



In tenacious soils, tolerably free from stones, the curved form, Fig. 120, is preferred to those that are flat; but for subsoils with stones im-



bedded, the straight form, Fig. 122, is the best adapted. A shovel much bent at the

neck, and pointed (Fig. 121), is useful for finishing the bottoms of some kinds of drains. A spade (Fig. 123), with the handle considerably bent, is also convenient in many cases; but a bent-handled spade is not so well adapted for penetrating a hard subsoil, as one in which both blade and handle are nearly straight. All these tools should be made of the best materials, and the iron straps from the sockets of the blades should be continued

up to near the cross handles. Long-handled scoops of various widths, and rounded or flattened in the soles (Figs. 124, 125, 126, 127, 129), are also employed. These are used for finishing the bottom for the reception of stones, flat tiles as a sole, or pipes. Such tools can be employed to reduce any slight irregularities, where the larger tools could not be introduced; and the more evenly the drain is cut out, and the smoother the bottom, the

Fig. 124.

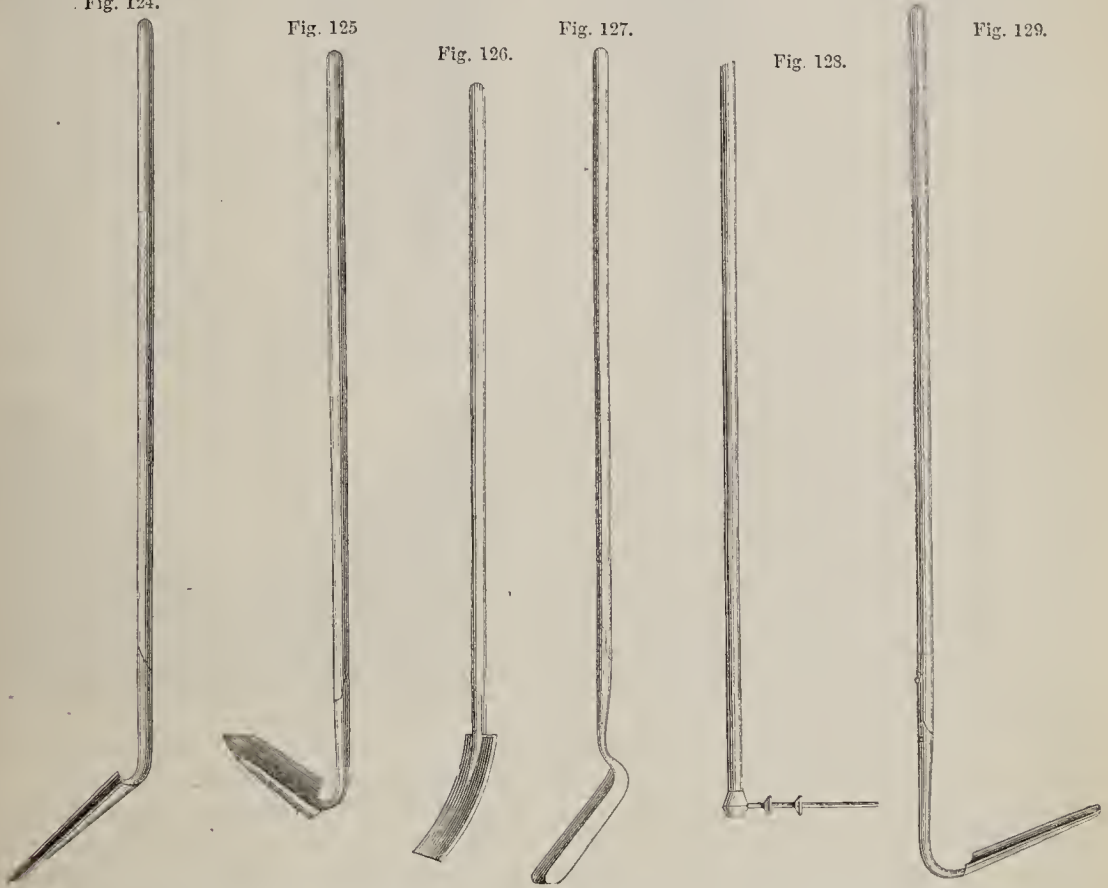
Fig. 125

Fig. 126.

Fig. 127.

Fig. 123.

Fig. 129.



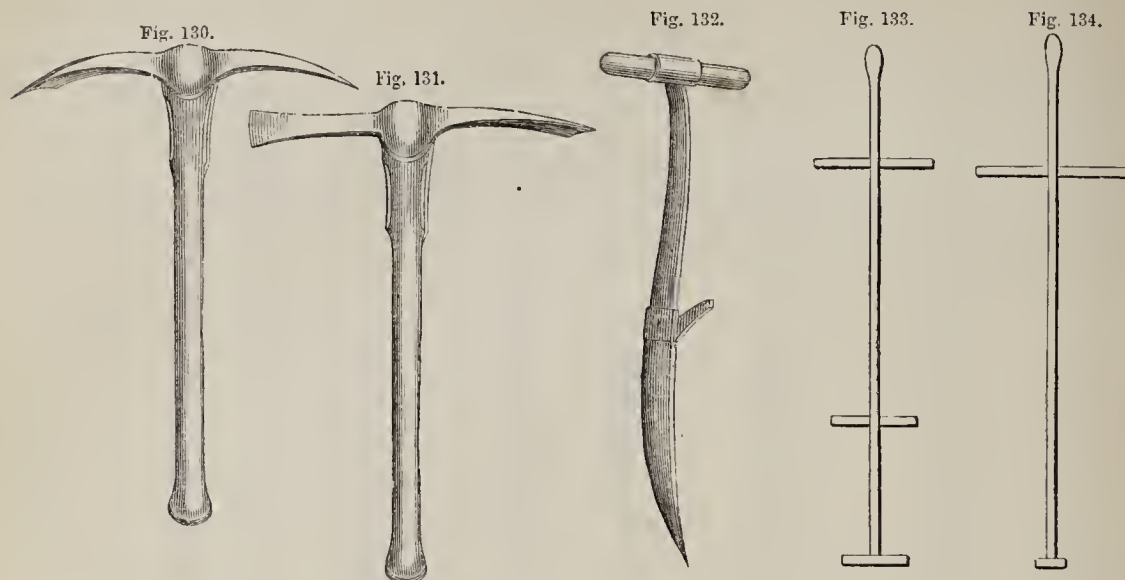
longer it will keep clear, and the better it will act. Where very hard strata have to be penetrated, a planter's mattock (Fig. 130), will be necessary. The mattock or grubbing axe (Fig. 131), will also be useful for cutting through roots of trees and similar obstructions.

The foot-pick (Fig. 132), has the advantage, that in using it the workman is on the firm ground, instead of treading on the portions loosened by the implement. For laying pipes in narrow and deep-cut drains in which a man cannot stand, an instrument called a pipe-layer (Fig. 128), is found very convenient. As guides for the workmen, drain-gauges made to show the depth and width of the drain, as in Fig. 133, or merely the depth, as in Fig.

134, are necessary. The former is made for stone drains, the latter for tile drains.

In all cases, it is desirable that the fall should be regular; but the greatest care is necessary where very little fall can be afforded; the workmen should therefore be provided with a level of the simplest form, such as they best understand, so that there may be the less chance of their not using it properly. This, most probably, is the mason's ordinary level, only it will be most convenient to have the stem high enough to admit of the plumb-line being seen above the level of the ground, whilst the base of the level is placed in the bottom of the drain. This instrument is, however, rather cumbersome, and might be superseded by a straight-edge, with a spirit-

level inserted, in the case of drains in which a man can stand to see the spirit bubble; or otherwise the foot-level (Fig. 76), constructed so as to span 10 feet, might be used, a thick-



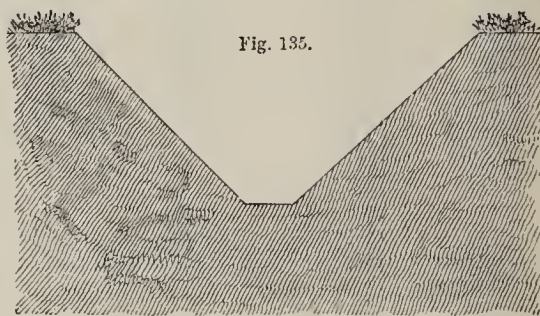
ness equal to the fall of the drain in that distance being added below one of the feet of the instrument.

Various kinds of drains are formed, to suit different circumstances; they are usually divided into two classes, *open* and *covered* drains.

Open Drains.—The open drain, or ditch, is doubtless the original mode of draining off superfluous moisture; but it is now mostly superseded by covered drains; for these do not occasion waste of ground for crops, or obstructions on the surface; and they are ultimately the cheapest, open drains being apt to break down at the sides, and fill up with weeds, so that much expense for frequent scouring is incurred. In their usual form, moreover, open drains or ditches, in or near gardens, are unsightly. If they are in any case admitted, they should be made in the form of ornamental water-courses, their sides being constructed with that view; and their bottoms should be built channels, no larger than will at all times be amply sufficient for the quantity of water which may pass along them.

The slope for the sides of open drains in garden soil ought not to be less than 45° . In this case, the width at top is equal to twice the depth, added to the width at bottom. Fig. 135 represents an open ditch, with the sides sloping at an angle of 45° , the width being 7 feet at top, 1 foot at bottom, and the depth 3 feet. On a slope of this amount, grass can be laid, and kept mowed; but whether turfed or not, it would be a great improvement on the usual form of the open ditch, if

a built channel were constructed either square or semicircular, but in such a way that there



may be at least a foot of level turfed margin on each side of the channel.

Covered Drains.—Some of these are formed by cutting out a narrow trench, and making the bottom still more narrow, so that when a thick turf is put in, a cavity for the water is left; others are filled up with fagots. It is needless, however, to notice these particularly, as stone or tile drains are so much superior to them.

Stones are plentiful enough in some places, and may very well be used for the purpose of draining; and draining tiles can easily be obtained of any form, and at a reasonable rate, owing to the great improvements in the machinery employed for their manufacture. In many cases, it is desirable to construct stone drains, in order to get rid of stones taken out of the ground in trenching to the proper depth. They can be made to act very well; but they may, like most kinds of drains, get stopped; and when this occurs, they cannot

be so easily taken up and relaid as tile drains, owing to the wedging of the materials, and their greater weight as compared with that of tiles. There are three kinds of stone drains: the *box drain*, the *couple drain*, and the *small stone or rubble drain*.

The box drain (Fig. 136) is chiefly formed

Fig. 136.

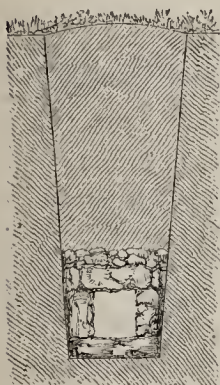
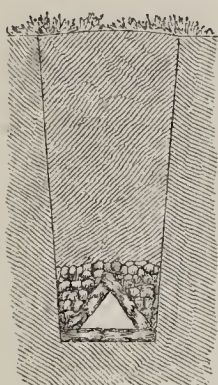


Fig. 137.



with flat stones. Drains of this kind are best made with a paved sole, for which the largest stones should be selected, and those best adapted for covers should be reserved. At the same time great care should be taken to lay the soles flat, so that no part of the bottom stand so much as an inch above its general run, which can be ascertained by placing a straight-edge along the bottom. This being so far correct, the sides are built to the required height, packing in some smaller stones to keep the others steady; the covers are then laid over, taking care to place their flattest sides downwards, so that there may be no projections into the cavity. Small stones are then put over the covers. A layer of heath, fibrous turf, or other tough substance, should be placed over the stones, in order to prevent the soil from mixing with them; and if some coal ashes were then scattered over this layer, they would tend to prevent the worms from affecting the drainage.

The coupled drain (Fig. 137) is formed by putting flat stones in the bottom for a sole, and upon this two other stones are placed, with their upper edges leaning against each other, so as to form a triangular cavity. The spaces between the sides of the drain and those of the cut trench, may be filled up with smaller stones, and precautions similar to those employed in the preceding case are necessary to prevent the soil from closing up the drainage.

Figs. 138 and 139 represent sections of

small stone or rubble drains. They are 7 inches wide at bottom, and 9 inches wide at

Fig. 138.

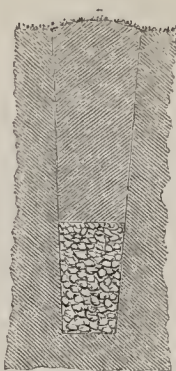
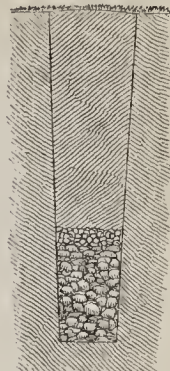


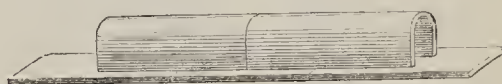
Fig. 139.



the top of the stones, the depth of the latter being 15 inches. These are reckoned to be good proportions. The stones should be broken to the size of road metal; and it is a good plan to put a layer of very small stones, several inches thick, over the others, as represented in Fig. 139; for by so doing, the earth is prevented from passing down so readily among the lower portions of the drainage. Rubble drains are not so well adapted for gardens as box drains; for rich soil, such as that of gardens, usually abounds in earth-worms, by the workings of which the drains are apt to be compactly cemented. They may, however, be adopted with advantage in some cases; for example, an orchard may require a certain amount of drainage when the trees are first planted; but when they get large, it is frequently the case that they require all the moisture they can get; so that if the rubble drains cease to act after the lapse of some years, the want of drainage will not be felt.

Tile Drains.—Experience has proved these to be, in general, the best and cheapest drains; and consequently they are the most in use. There are several kinds of them. Fig. 140

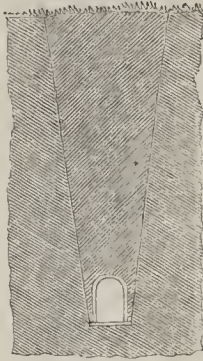
Fig. 140.



represents the horse-shoe tile and its sole. The latter is sometimes dispensed with; but it is considered bad economy; for in most sub-soils the bottom of the drain becomes soft, and allows the horse-shoe tiles to sink, diminishing the opening not only by the amount of sinking, but likewise rendering it liable to be completely choked up; for if one should

sink and the other should not, there will be an opening at top between the two, through which soil will get in. This cannot take place to any extent where tile soles are used, especially if care be taken to place the horse-shoe tiles so as to break bond, that is, to rest on two adjoining soles, as they are represented in the figure. The sole tile should be carefully bedded, so that when pressed, it may be quite flat. Some fibrous materials should be placed over the tiles, previously to the earth being filled in. Fig. 141 represents a section of the finished drains.

Fig. 141.



Pipe Tiles.—These are made of different shapes, but chiefly cylindrical, as in Fig. 142.

Fig. 142.



The cylindrical form is found, on the whole, to be the best. It can be laid with the greatest facility, and it retains its position better than the oval form, especially when the trench is properly cut out by means of the bottoming tools (Figs. 118, 119, 120).

The width of the trenches should be just sufficient for a man to work them out. If the top soil is of a loose nature, as much slope should be allowed as may be found necessary to prevent the soil from crumbling in whilst the drain is being laid. In clay soils, when the trench is cut out to within 9 inches or a foot of the intended depth, the bottoming tools should be employed to cut out a groove merely wide enough for the reception of the

Fig. 143.

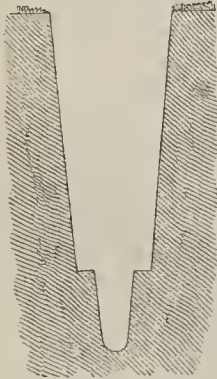
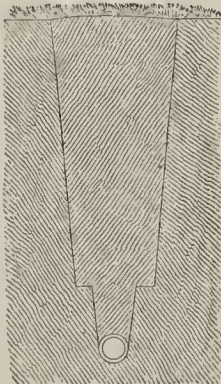


Fig. 144.



pipe, as in Fig. 143. In gravelly or stony subsoils, it may only be possible to cut a nar-

row groove so deep as 9 or 12 inches; but a depth equal to the diameter of the pipe should be grooved out, so that the pipes may bed in the solid ground as accurately as possible. In Fig. 144, a section of the finished drain is represented.

Pipe tiles are sometimes furnished with collars, as represented in Fig. 145. These

Fig. 145.



collars should be employed in draining gardens, as they not only tend to keep the pipes from shifting, and thus interrupting the continuous flow of the water, but also to prevent roots from insinuating themselves into the drains. The size of the pipes, or width of their bore, depends on the quantity of water which ought to be carried off. What this may be it is difficult to ascertain. It may be only that from the rain which falls in the locality; or the accession of springs, and the length of the drains themselves, may also have to be taken into account. Where the subsoil is properly regulated in the formation of the garden, and where the fall of rain does not much exceed 24 inches per annum, little or no drainage is required on that account. The quantity of superfluous water from the accession of springs is the main consideration, and must be estimated from trial, by cutting. With regard to the length of the drain, it is easily understood that if pipes of a certain capacity are necessary for a certain length of drain, and if that length be increased, the capacity of the pipes, or at least of those towards the lower end, must also be increased. In all cases, however, it is well to make sure of ample capacity for drawing off all superfluous water that may at any time collect. Mr. Parkes, in his *Philosophy of Land Drainage*, gives some data resulting from experiments made with regard to the quantity of water discharged by 1-inch drain pipes. He states that "the drains were 24 feet asunder, and each pipe 1 foot in length, so that each lineal foot had to receive the water falling on 24 square feet of surface, equal to 60 lbs., or 6 gallons; and as the time which this quantity occupied in descending through the soil and disappearing, was about forty-eight hours, it results that $1\frac{1}{4}$ lb., or 1 pint per hour, entered the drain through the crevice existing between each pair of pipes. Every one knows,

without having recourse to strict experiment, how very small a hole will let a pint of water pass through it in an hour, being only one-third of an ounce per minute, or about twice the contents of a lady's thimble.

The weight of rain per acre which fell during the twelve hours, amounted to 108,900 lbs., or 48·5 tons, which, on the whole piece of 9 acres, is equal to 437·4 tons; and each drain discharged 19 tons, equal to about four-tenths of a ton per hour, on the mean of forty-eight hours; but when the flow was at the greatest, I find that each drain must have discharged at the rate of five times this quantity per hour, which affords proof of the faculty of the pipes to receive and carry off a fall of rain equal to $2\frac{1}{2}$ inches in twelve hours, instead of $\frac{1}{2}$ inch—a fall quite unknown in this climate."

An inch deep of rain in twelve hours is a heavy fall; it is equal to 22,622 gallons per acre, or 226,225 lbs., or within 15 lbs. of 101 tons. This is more than twice the quantity which Mr. Parkes actually found the 1-inch drains at 24 feet apart discharged in the course

of forty-eight hours; but, as he observes, that when the flow was greatest, the drains must have discharged at the rate of five times the quantity he mentions, or as much as would be derived from $2\frac{1}{2}$ inches of rain, it may be concluded that pipes of an inch bore in drains 24 feet asunder, will be more than adequate to discharge in forty-eight hours the superfluous water produced by the heaviest rains which occur in this country, provided no stoppage take place in the pipes. In Mr. Parkes' experiment, it may be presumed that the pipes were all in good working order; but after a time, it must be expected that obstacles to the free passage of water through the pipes will arise, in consequence of which many of them will have the bore partially, and some of them entirely filled up. It is therefore advisable, in gardens, where there is generally a difficulty in relaying the pipes, in consequence of trees, to use either a horse-shoe tile and sole, or pipe tiles of not less than 2 inches in diameter. Where springs abound, even 3-inch pipes may be necessary.

Figs. 146, 147, 148, 149, and 150, represent

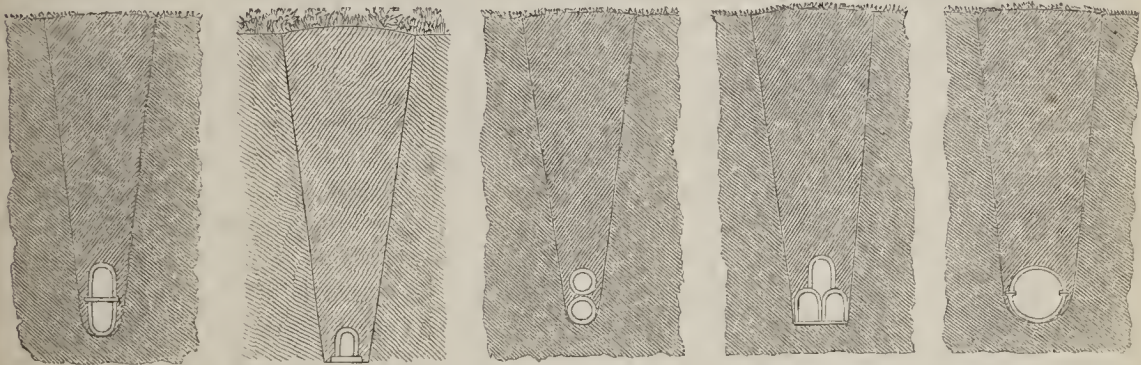
Fig. 146.

Fig. 147.

Fig. 148.

Fig. 149.

Fig. 150.



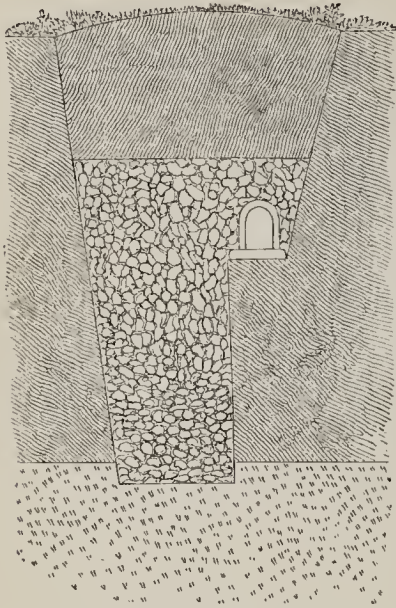
various modes of forming main drains, one or other of which may be adopted according to circumstances. Fig. 146 is a combination of two horse-shoe tiles, with a tile sole or slate between them. In many cases the lower half of a drain may be so formed, whilst the single tile (Fig. 147) may be sufficient for the upper half. Fig. 150 is well adapted for allowing a large quantity of water to pass; the same may be said of the arrangement seen in Fig. 149, which affords a chance that if roots get into one or even two of the openings, still the third may be clear to act.

Depth of Drains.—In some cases the depth of drains is limited by the outlet. Where this allows of sufficient fall, the top of the materials forming the drain should not be less

than 3 feet below the surface, in order that they may not interfere with occasional deep trenching, and that they may be further removed from the danger of getting choked by the roots of plants. If circumstances will permit, it is desirable that the drain should be cut to the depth of 4 feet. In order, however, to accommodate the drain to porous strata, a greater depth may be necessary, or, for the same reason, a less depth than 4 feet may be advisable, notwithstanding some inconveniences arising from proximity to the surface. Instead of a very deep cutting to reach a watery stratum confined beneath an impervious layer, a drain may be cut 4 feet deep, and then small wells sunk and filled with stones, as represented in Fig. 151. The con-

duit is formed on one side, on a sole, and small stones are filled in about a foot above it.

Fig. 151.



Frequency of Drains, or the Distance they should be Asunder.—The distance at which drains should be formed, depends on various circumstances; chiefly, upon the porosity of the soil or subsoil. Some kinds of subsoil are so porous that drains will draw water a great distance through it; in adhesive soils, on the contrary, they draw comparatively a little way. Smith recommends from 10 to 15 feet from drain to drain in adhesive soils, and in lighter and more porous soils, from 18 to 24 feet. Parkes, in his *Philosophy and Art of Drainage*, recommends the deep and distant drain system. His practice was to make drains from 4 to 6 feet deep according to soil and outfall, and from 24 to 66 feet apart. Morton (*Cyclopedia of Agriculture*, vol. i. p. 701) says: "We have found a distance of 24 feet with a depth of from $3\frac{1}{2}$ to 4 feet, produce very perfect results on soils of considerable tenacity, in districts subject to more than the average fall of rain in the British islands. These will be found safe examples to follow under similar circumstances; and, where there is nothing in the formation of the subsoil calling for a particular arrangement to meet it, these intervals and depths will generally be found perfectly successful."

Direction of the Drains.—In level ground, the direction of the drain is, of course, determined by the outlet, or by a main drain communicating with some place of outfall. Where

there are no springs, and only the superfluous water resulting from a wet climate has to be drawn off, the drains should run in the direction of the slope of the ground, with, perhaps, a few diagonal or branch drains. If a watery stratum, causing springs, is to be intercepted by a deep drain, such ought to be more or less oblique to the direction of the stratum; for it is certain, that by crossing the slope of the stratum at right angles, the drain will be level; or, if cut so as to have a fall, part of its extent will be under the stratum.

"In many subsoils there are thin partings, or layers of porous materials, interposed between the strata, which, although not of sufficient capacity to give rise to actual springs, yet exude sufficient water to indicate their presence. These partings occasionally crop out, and give rise to those damp spots which are to be seen diversifying the surface of fields, when the drying breezes of spring have begun to act upon them." See Fig. 109, in which the light lines represent such partings.

"Now, it will be evident, in draining such land, that if the drains be disposed in a direction transverse or oblique to the slope, it will often happen that the drains, no matter how skilfully planned, will not reach the partings at all, as at A. In this case the water will continue to flow on in its accustomed channel, and discharge its waters at B. But again, even though it does reach these partings, as at C, a considerable portion of water will escape from the drain itself, and flow to the lower level of its old point of discharge at D. Whereas, a drain cut in the line of the slope, as from D to E, intersects all these partings, and furnishes an outlet to them at a lower level than their old ones."—(Morton's *Cyclopedia of Agriculture*, vol. i. p. 701.)

In commencing the operation of cutting the drains, the place of outfall previously determined by levelling, should be cleared. If it be an open channel, irregular in width and depth, means should be taken to regulate it in these respects, so that after heavy rains the water may flow on without rising so high as it would otherwise do if its course were obstructed by contractions and irregular bends. A few pieces of rock, or a portion of some hard stratum across the bed of a rivulet, render tracts of ground liable to be flooded a long way back. The narrow crooked channel may be regulated; but overflowing will still occur whilst obstructions of the nature alluded to

are allowed to remain. If, from examination and trial by levelling, it is found that there are obstructions, near or remote, that can possibly influence the level of the water at the outfall of the drains, means should be taken to remove such obstructions. The outlets of the main drain should be, if the declivity will permit, several inches above the surface level of the water in the channel of outfall. Drains on different sides of the same channel of outfall should not enter it exactly opposite each other, nor should any drain be led into the outfall, or into another drain at right angles. Although the general direction of drains will often be at right angles to the channel into which their water is discharged, yet, on approaching it, they should form a gentle curve in the direction of the stream or main drain, so as to enter at an acute angle. In this way the forces of the two streams, instead of acting against each other, will unite to clear away the mud that would otherwise accumulate at the mouth of the drain. If possible the smaller drains should have as much as 3 inches of a fall into the larger or main drains; and more than this, for the general outfall, would be desirable. It is a bad plan to terminate the minor drains in an open ditch, as they are apt to get choked when their discharge is too weak to clear themselves. They should, therefore, be made to fall into main drains, from which the collected water will be discharged with greater force, and thus keep their outlets clear.

The main drains should be cut first. The others should be laid as soon as they are cut out, commencing the laying at the top of the drain, or the place farthest from the outfall, and terminating in the main drain, with which each junction should be carefully made. If the main consist of tile pipes, there should be branched ones for the junctions; or, if not, a hole should be cut out in the side of a main pipe, into which the terminating pipe of the minor drain ought to be neatly fitted. When the first drain is laid into the main, the latter should be laid as far as the entrance of the next minor drain, and thus the work should proceed till the whole is completed to the place of outfall.

III.—BORDERS FOR FRUIT-TREES.

In some cases the soil intended for a fruit and kitchen garden is so good, that the borders require nothing beyond trenching and

manuring, in common with the rest of the ground. But frequently other means have to be employed to render borders suitable for fruit-trees. If the soil is bad, it may have to be removed, and a better description substituted. Both soil and subsoil may have to be moved, and this should be done before the rest of the ground is trenched, for otherwise the conveyance of materials would be rendered difficult, in consequence of their having to be taken over the loosened ground, to the injury of the latter. For these reasons, the formation of the borders should precede the trenching of the rest of the ground.

Width of Fruit-tree Borders.—The width of the borders is the first consideration. It was formerly recommended by various authors, to make the width of the borders equal to the height of the walls; but this rule should not be implicitly followed in every case. The walls of the royal gardens at Frogmore are all 12 feet high, but some of the borders are 15 feet, others 18 feet wide, a greater width being allowed for borders appropriated to the growth of pears than to those for peaches and nectarines, because the roots of the former extend farther than those of the latter kinds of fruit-trees. The principal consideration in determining the width of the border, is the extent necessary for affording the roots sufficient nourishment. This partly depends on the nature of the soil, subsoil, and warmth of the situation. If the soil is naturally rich, or artificially made so, it will contain more nourishment in less compass than where the soil is of a poorer nature. If the subsoil is bad, and the situation cold, then the borders should be made comparatively shallow, in order to keep the roots near the surface; and as these are thus necessarily prevented from penetrating far downwards, they should have the more space allowed them to extend outwards. As borders can be cropped, it may be urged that there can be no loss of produce by making them broader than the trees may absolutely require. For the growth of certain vegetables—many of the smaller kinds, for instance, that require a warm soil and sheltered situation, and that do not root deeply—borders are preferable; but there are others that require the ground to be trenched occasionally, and this cannot be done when the border becomes occupied with the roots of the trees. If the borders of a garden containing an acre were 18 feet wide, they would occupy more than

one-third of the area remaining for cultivation, after deducting space for walks. In gardens of still less extent, if the breadth of the borders be the same as in the above, their area will of course bear a greater proportion to the rest of the ground; consequently, some kinds of vegetables which are taller and deeper rooted than would be desirable for borders, would have to be grown on them. Rather than do this, it will be advisable, in such cases, to limit the width as much as can well be done, consistently with the actual requirements of the trees.

A fruit and kitchen garden of the extent of 1 acre, or less, may have the borders 12 feet wide from the wall to the edge of the gravel walk; but the ground below the latter should be made good, if it is not so naturally, in order that the roots may extend and feed under it. If the garden contain between 1 and 2 acres, the borders may be 15 feet; and if more than 2 acres in extent, they should be 18 feet wide; and this we consider to be the greatest width that any fruit-tree border need be formed under any circumstances. Whilst some would allow as much as 18 feet for the border, in front of the south aspect wall, yet they prefer a width of 12 or 15 feet for those in front of the east and west aspect walls. It is true the south aspect border is the most important, and the most useful for producing early crops, nevertheless, it must be borne in mind, that espalier trees, that may be planted on the opposite side of the walk, tend to shade the trees on the wall, not, perhaps, from the direct rays of the sun, but from a certain portion of the sky illuminated by those rays. When the border is 18 feet, instead of 15 or less, there is so much more clear space for the play of light on the trees; and it is well known that these, whether on an eastern or western aspect, require all the light they can possibly receive; therefore, it is advisable that a wide border should intervene between them and the espalier trees. From what has been stated, we may conclude, that where the soil is good and the garden not large, 12 feet may be taken for the breadth of the borders. If the soil is necessarily shallow, it would be desirable to add 2 or 3 feet more to the width. Lastly, in large gardens, where there is plenty of ground for the strong growing crops, the borders should all be 18 feet wide.

Depth of Fruit-tree Borders.—There is much difference of opinion with respect to the depth

of borders. Some authors recommend them to be as deep as 3 feet, some as shallow as 15 inches, and these may be considered as extremes, between which various depths, as 18, 21, 24, and 30 inches are recommended. Shallow borders are advocated on account of their maintaining the roots near the surface, and, consequently, more within the heating influence of the sun's rays. Provided the border is well drained, and the subsoil completely freed from stagnant water and the chilling effects of water springs, there is less to be feared from cold in a border, made of the depth of 3 feet, than is generally supposed. This will be seen by the following table, which exhibits the mean monthly temperature of the soil at the depths of 1 foot, 2 feet, and 3 feet below the surface, in ground naturally well drained:—

Months.	Average Temperature of the Soil at—		
	1 foot deep.	2 feet deep.	3 feet deep.
February, ...	40.1°	39.7°	42.4°
March,.....	39.1	38.9	41.1
April,.....	44.5	43.5	44.8
May,.....	51.4	49.3	50.7
June,.....	56.7	54.1	55.0
July,.....	65.5	62.8	62.8
August,.....	62.3	60.5	62.0
September, ..	57.6	56.8	59.4

From the above it appears that the soil at 3 feet deep is, on the average, quite as warm as it is at 1 foot, and even warmer than at 2 feet deep. In winter the ground at 3 feet deep is warmer than at 2 feet. Twice a-year, towards the end of April, and the end of August, the temperature of the ground at 1 foot and 3 feet deep is equal. In winter, then, the roots in a deep border are warmer than those in a shallow one; but in summer the roots in shallow borders have the advantage of a temperature 2 or 3 degrees higher, but as the difference scarcely averages 2 degrees during the months of May, June, and July, it may not be of such importance as many have supposed. The effects of 2 or 3 degrees of heat are certainly not to be overlooked; but the absence of that amount cannot be supposed to produce the great difference stated to have been experienced, in some cases, between the results obtained from trees planted in shallow and in deep borders. Instances have been recorded of the good effects which have resulted from taking up the trees, and replanting them after making the borders more shallow; but it should

be borne in mind that the removal and replanting of the trees, even in the same depth of soil, would of itself be the means of rendering them more productive. The only fault of the trees was, perhaps, their over-luxuriance, arising from the very favourable condition in which the roots were placed, a condition requiring no change, provided the trees could have been once brought into a bearing state, and this can, in many cases, be done merely by good management in summer pruning. When they have to support a heavy crop, over-luxuriance in wood and leaves is sufficiently checked, and then there is no cause for complaint of the depth of the soil affording too much nourishment.

Trees may bear abundance of large fruit, which, in a good climate and favourable aspect, may ripen perfectly. The fruit may also be large and abundant, under less favourable circumstances of climate and aspect, but the flavour may be deficient. In this case, the amount of nourishment is evidently too much for the climate, and it becomes a question how this amount is to be reduced; whether by allowing a less quantity of the same rich kind of soil, or the same quantity but poorer in quality; in other words, whether the border should be made shallow and rich, or deep, but composed of materials that can only afford a limited supply of food. A deep, but very poor soil, we consider to be objectionable; and equally so, on the other hand, one that is very shallow, but exceedingly rich. We believe that the best conditions for a border, under such circumstances, will be intermediate as regards these extremes.

Near London, in ordinary seasons, excellent crops of peaches and nectarines are produced, although the trees in some gardens are grown in borders, which, in many cases, have received no artificial making, except merely trenching to the depth of 2, 2½, or 3 feet, some manure being given at the same time. The subsoil is a yellow, compact, sandy loam, adhesive when wet, and when turned up hardening with drought, after being soaked with rain, but falling, tender like slaked lime, on again acquiring moisture. It rests on a bed of gravel, and is, in consequence, naturally well drained; the temperature averages quite as high at 3 feet as at 1 foot below the surface. Trees in such soil thrive well for several years, although the soil be trenched only 18 inches deep, or down to the loam; but this they readily pene-

trate when it is soft and moist, and in a dry hot summer they grow amazingly. In one, two, or three years more, however, the trees draw all available moisture out of the stratum of loam, which is then a compact dry mass, and such it generally remains, even after a very wet season. The roots so abundantly formed in it, when it was in a moist state, find themselves completely deprived of the moisture by which they were enticed downwards, and having nothing to draw from, they must fail in supplying the same quantity of sap as they formerly did. The trees soon exhibit signs of this privation, and sometimes never recover from its effects. Whether the border be trenched or not, the roots will penetrate quite to the depth above mentioned; but when the stratum of loam is broken up, the consequences of their doing so are far from being so disastrous, for the loosened soil can at any time be more readily moistened than the dry loam; and rain, or water otherwise supplied, will have more free access among the loose particles, than among those of the more compact mass of dry maiden loam. In a favourable climate, therefore, and when the soil is good, with a loamy subsoil, a depth of 3 feet is necessary for fruit-tree borders, in order to break up the loamy substratum, which, although easily permeable to the roots when it is moist, yet to moisture it is not so when it has once become dry, if allowed to retain its original compact state. There is no danger of the natural soil being too rich, provided it be friable and the border well drained. The excellent soil of the fruit-tree borders of the royal gardens at Frogmore, is a proof of this. The trees produce vigorous wood, but with good management are not over-luxuriant, and they make substantial growth early in the season. In a strong clay soil, on a badly drained subsoil, the vegetation of the trees is more backward, and they generally commence an excessively vigorous growth after midsummer, so that, if the strong shoots developed after that period be stopped, the resulting laterals have not time to become thoroughly matured before winter. It may be concluded from the foregoing considerations and facts, that a depth of 3 feet may be allowed for borders in a good climate, other circumstances of soil and subsoil being likewise favourable. The above depth may, however, be considered the maximum; and we now come to examine those conditions under which a less depth should be adopted.

Where the climate is not so good as to ripen fruit of large size, such as borders affording much nourishment are calculated to produce, the supply of food must be diminished in order to produce shoots that will not be more vigorous than can be well matured, and fruit not larger than the amount of sun heat is adequate to thoroughly ripen. Presuming that the soil is a good loam, but the climate not so good as that for which a depth of 3 feet was recommended, that of $2\frac{1}{2}$ feet will be advisable; and in a climate still less favourable, the depth may be reduced to 2 feet; or, if the subsoil, as well as the climate, is cold, 18 inches may be proper, but this is the least depth we would recommend. As borders are usually formed with a slope from the wall to the edge of the walk, and as this slope is generally greater than that of the bottom of the border, it follows, that the depth of soil will be greater at the wall than at the side of the border next the walk. The several depths above mentioned are to be understood as mean depths; thus, where the depth of soil is recommended to be 30 inches, that depth applies half way between the wall and the side of the border next the walk. If the surface slopes 12 inches, and the bottom only 4 inches, and the mean depth be 30 inches, then the depth of soil next the wall will be 34, and at the walk 26 inches. But whatever the respective depths at the wall and front of the border may be, their mean is that to which we refer in speaking of the depth of borders.

The bottom of fruit-tree borders should have a regular slope from the wall towards the walk, where drainage should be provided. Some recommend a fall of 6 inches from the wall to the latter; but the amount should depend on the width of the border. In general, a uniform fall of 1 inch in 3 feet will be quite sufficient. This amounts to 4 inches for a border 12 feet wide; 5 inches for 15, and 6 inches for 18 feet wide. It is equal to a fall of fully 120 feet in a mile; and a stream flowing in a channel having this gradient, would certainly be the reverse of sluggish. So far, then, as a descent for stagnant water is concerned, the above may be considered, in any case, quite sufficient. In naturally dry subsoils, the slope may be less; yet we think that it should not be altogether dispensed with, because the fruit-trees usually planted against walls naturally thrive well on slopes. The roots of a tree planted against a wall extend outwards; and, consequently, in the direction of the slope.

This being the case, their extremities, which are the principal absorbents, are situated the lowest, just where they have the best chance of receiving moisture as it descends to them. If, however, the bottom were quite level, the extremities would have no more chance of moisture, than the comparatively naked roots near the stem, which less require it. From this it appears evident, that a little slope, even in dry soils, is beneficial.

The amount of slope to be calculated for the surface of the borders is more dependent on circumstances than that of the bottom. In localities where the climate is good, and where the average quantity of rain does not exceed 24 inches, the surface of the border may lie nearly level; for trees in such places require, against a south wall at least, all the rain that falls on the border, and frequently more. On the other hand, where the climate is cold and wet, a good slope is advantageous, not only for throwing off superabundant moisture, but also that the surface of the border may receive greater heat from the sun's rays, by being more perpendicular to them. In such a case, the slope may be as much as 1 in 12, or an inch in every foot; so that a border 12 feet wide, would be a foot higher at the wall than at the side next the walk; and if 18 feet wide, 18 inches higher; and so on in proportion. This slope may be allowed in cold wet situations; but under ordinary circumstances, a slope of 1 in 18, equal to 8 inches on a 12-foot border, or 12 inches on one 18 feet wide, will be sufficient.

The average depth of the border, the slope of its bottom, and that of its surface, having been decided upon, there yet remains for consideration the general level of the border relatively to that of the rest of the ground. Before the importance of subsoil drainage was so well understood as it is now, borders were sometimes made deep by excavating below the subsoil level of the rest of the ground. If the bottom were covered to some depth with draining materials, the excavation would only form a sort of rubble drain from the higher subsoil, without an outlet, filled with water which of course must be stagnant. The trees having their roots in this damp medium could not thrive; deep borders were blamed, the trees were taken up, the border made shallow, and they succeeded. The fact of their doing so was proof condemnatory of deep borders; but in many such cases we doubt not if the whole depth of the border could have been elevated

so as to rest as much above, as it was below the natural level of the adjoining subsoil, the trees would have succeeded equally well. The evil, in our opinion, lay not in the thickness of the soil, but in the sunken position which it was made to occupy. No cultivated plant thrives well with its roots below the surrounding subsoil. Even celery, though it naturally grows in ditches, will not thrive well when planted in very deep trenches in a garden; it need not, therefore, be a matter of surprise that fruit-trees do not succeed when placed in a similar condition. If the bottom of the border is lower than the adjoining subsoil, and the two are not separated by a drain, we may easily suppose that water will tend to sink into the bottom of the border, where it will be stagnant. It is not, however, so easy to conceive how the border could be affected if cut off from the rest of the ground by a drain. Let the accompanying figure (152) represent such, and let *a* be the subsoil level, below which complete saturation occasionally takes place. This being the case, moisture will, in some soils, rise to the same level at *b*, maintaining the bottom of the border damp, notwithstanding that the latter is above the bottom of the drain. From what has been above stated, and from experience, it is evident, that the bottom of a fruit-tree border should not be lower than the general level of the subsoil *a*, which would be the case if it were dug out down to *c*, that even at *b* it is liable to be damp, and therefore it is desirable that it should be formed at some elevation above the line *a b*, as at *d*. The height of the bottom *d*, above *a b*, should not be less than 3 inches, and were it not for diminishing by so much the height of the wall, it might even be a foot. This would involve the additional expense of four more courses of bricks; but if that could be afforded, it would be compensated by the advantages arising from the roots of the trees being perfectly secure from an excess of moisture, and both foliage and fruit would be more exposed to air and light. In low damp situations these advantages are of great importance; therefore, in order to obtain them, whether the soil of the border be made deep or shallow, or whether it slope much or little, the bottom of the border should be made on a higher level than that of the subsoil of the rest of the ground. By so doing, however, the surface of the border will likewise be raised above the general level, un-

Fig. 152.



less the border have a less depth of soil than the rest of the garden. It becomes a question, whether the level of the walks should be made to correspond with the general level of the ground, or with that of the border. Some approve of the former, and in cases where it is advisable to raise the border considerably, they recommend that a low parapet wall should be built along the front of the border. This, however, will be best taken into consideration when we come to treat of laying out the walks, and we shall, therefore, only remark at present, that the borders should be formed irrespective of the walks, according to the principles best calculated for the success of the trees.

It is a question whether fruit-tree borders should be paved in the bottom, laid with concrete, or otherwise rendered impenetrable to the roots of trees. Mr. Keane states, in the *Gardeners' Chronicle*, 1848, p. 781, that "the soil of the most productive part of Kent is locally called hassock, or stone-shatter; the surface of this is a mixture of sandy loam, largely intermixed with small pieces of light-coloured Kentish ragstone; it is from 6 inches to 2 feet deep on solid stone rock. This land produces great quantities of hops, apples, cherries, filberts, and likewise good turnips, potatoes, seeds, and corn; also much excellent hay on old grass lands. Fruit-trees of all sorts flourish and produce abundantly; even peach and pear trees of the most delicate kinds grow with the greatest luxuriance, and are free from disease. To what are we to attribute such results? not to the climate, for localities enjoying a higher degree of temperature than the neighbourhood of Maidstone, do not produce such fruit. The answer, then, resolves itself into the fact, that the quantity and superior quality of the fruits are due to the soil being naturally in that state best suited for their healthy growth." Mr. Keane further observes, that fruit-trees, growing in such soil, produce short-jointed wood; they grow slowly, and their tissues become perfectly organized as growth proceeds. Here we have a naturally hard bottom producing a healthy vegetation. Mr. Fleming has concreted the fruit-tree borders at Trentham, as a means of preventing the injurious effects of the dampness of the soil and situation. This proceeding has produced very satisfactory results. We may therefore conclude, that paving with stones, tiles, bricks, slates, or concreting the bottoms of fruit-tree borders, is to be recommended, in all damp situations, as

highly conducive to the success of the trees; and also where the subsoil contains substances which act injuriously on vegetation. In such cases, there can be no question as to the utility of the process of close paving; and, therefore, where expense is no object, it should be carried out. When, however, the subsoil is good and not over-moist, paving is superfluous, except it be resorted to with the view of limiting the supply of nourishment, where this is so abundant as to produce a more luxuriant growth than the climate can render perfect. On this subject, Mr. Fleming makes some very judicious remarks in the *Gardeners' Chronicle*, 1849, p. 68; alluding to the gardens at Trent-ham, he says—"As the situation of these gardens is very low and damp, I find it an advantage to concrete the floor of the border, as well as its surface; for it is necessary to prevent the roots from descending into the subsoil, which is a wet stiff clay, and owes its superabundant moisture to the close proximity of a river. Wherever the same natural disadvantages have to be contended with, this double concreting will be found useful; but in medium soils, where the substratum can be effectually drained, the lower concrete is unnecessary, and, in many instances, would be worse than injurious, as the border would be liable to get too dry in summer. Wherever the soil is open, and the substratum naturally dry, concreting is altogether unnecessary. The utility of practice will, of course, depend upon the peculiarities of the climate, soil, and situation, concerning which, every one must be guided by his own judgment; but I can safely affirm, that here concreting has been of immense advantage."

Concrete, which signifies to *coalesce in one mass*, is usually composed of a mixture of lime, gravel, and sand. It is now much used for the foundations of walls, and in most situations the whole of the basements of houses are laid with it. A composition that will answer in these cases, will likewise be suitable for fruit-tree borders. A writer in the *Gardeners' Chronicle*, 1842, p. 571, says, "The best mode of forming what is now called concrete foundations, is a question on which there exists much difference of opinion; nor is this difference likely to be very soon settled, for this reason—that any mode in which there is the commonest attention to the known principles of calcareous cements, will do sufficiently well." He then proposes to use a layer or

layers of such stones as are fit for macadamizing a road, either larger, smaller, or mixed, and then to fill up the interstices of these stones with a cement of sharp sand and good stone lime, the latter having been ground hot, and not slaked in the usual way. "One part of lime and two or three of clean sand, well beaten up together, will make a very good mixture for this purpose. The great difference of opinion arises out of the mode in which the lime and sand shall be mixed with the stones, and the whole made compact in the trench. One mode, it is obvious, would have been to pour the lime and sand in a fluid state, upon each stratum of broken stones as they were laid in the trench, first ramming down the stones as much as was thought necessary, then pouring on the cement, and afterwards not disturbing that layer. This plan has by some been recommended, and is in my judgment the best mode. The ordinary process is to mix the stones, sand, and lime, with enough of water, and to throw the whole into the foundations from a great height; the object of the fall being to give compactness, which is not, I think, to be so obtained. The fall produces a *scattering* action in the mass, which appears to me unfavourable to compactness." Practically, however, it is found that concrete dropped from a height acquires the greatest solidity, and this is the mode adopted in and near London.

"With these general principles," continues the writer above quoted, "any one can form and use concrete effectually. Hard clean stones, clean sand mixed with as little clay as possible, and no humus, well-burned stone lime, or good chalk lime, and if slaked instead of being ground, it will not matter much; these materials packed closely in a trench, and disturbed as little as may be after the lime has begun to set, will make a good concrete foundation. Where good clean gravel, or gravel from which the clay has been washed, can be obtained, that will at once furnish both the stones and the sand, requiring merely the admixture of about one-eighth of lime; the mixture may be laid in the trenches in layers of 3 or 4 inches, and rapidly trodden down; or it may be thrown in from a height, according to the London practice, if that be preferred."

"The essential quality of concrete seems to be, that the materials used should be of small dimensions, so that the cementing medium

may act in every direction round them, and that the latter should on no account be more in quantity than is necessary for that purpose. Architects and engineers have much varied the proportions of lime and sand used. If the lime, which should be fresh and ground to powder, be good stone lime, such as that from Dorking, used in the neighbourhood of London, it will bear three or four times its measure, by bulk of sand. These, and the ballast or gallots, as the stone chippings are called, should be thoroughly turned over and mixed together. It is then filled into the barrows, and run on to be dropped from a stage into the foundations. This latter operation should be performed at as great a height as possible above the level of the trench, in order that the whole of the different particles of the composition may be compressed together, so as to occupy the least possible space. The stones employed should not exceed the size of a common hen's egg; the mass very quickly sets and becomes extremely hard."—(Brande's *Dictionary of Science, Literature, and Art*.)

"The proportion of hot lime to the gravel, is about one-eighth part only. Others use lime in the proportion of one to five of loamy gravel. In countries where gravel is not common, dry brick rubbish, broken stone, flints, or any material that will bind into one mass, will answer."—(Loudon's *Encyclopedia of Cottage, Farm, and Villa Architecture*.)

Mr. Fleming uses one part by measure of lime, and eight parts of gravel. Others approve of five parts of stones, one of sand, and one of lime; and we consider these to be very good proportions; but whether a greater or less quantity of lime be used, the stones and sand employed in the composition for border floors, should be as clean as possible, for if there were loamy substances or patches of garden soil amongst the concrete, the roots of the trees would take to such, and might penetrate into the substratum.

The thickness of the bed of concrete may be about 4 inches. Presuming that this is the case, and that lime constitutes one-seventh of the whole mass, the quantity of lime required for concreting a border 18 feet in breadth, will be about 53 bushels for every 100 feet run. The cost of the lime would not be great, and in many cases gravel will be found near the spot; so that the principal expense is the labour. A concrete formed as above will be strong; but if stones fit for the

purpose are not plentiful in the locality, sand and lime in the proportion to form a mortar—say one part lime to three or four of sand—will resist the roots of trees; and if laid on a bottom of as nearly uniform solidity as possible, it will not readily break with ordinary care. This may be found cheaper, or at all events there will be less weight of materials required than in concreting. Whatever mode be adopted, we may feel assured, that in all cases where the borders do not naturally possess a good bottom, the expense will be amply repaid by superior crops. The first expense of the process is the only one, but on the other hand the advantages are permanent. The border may be made of the best materials at great expense, but this would be in a manner thrown away, if the soil were laid on a bad substratum.

In proceeding to lay down the concrete, great care should be taken to prepare for it an even floor of uniform solidity. The breadth of the border should be marked off into three divisions, or into two, if the border is narrow; the soil of the one next the wall should be cleared out to the proper depth, throwing it so as to form a high ridge between the excavation and the walk. The bottom of the excavated portion should next be made level, rammed equally all over, and any inequalities resulting from this operation should be regulated. The whole should then be trodden, raked, and well rolled. If the concrete materials were mixed on this, the even surface would be destroyed, and the soil, notwithstanding the greatest care, would be occasionally shovelled up amongst the other materials. It would therefore be preferable to have a moveable wooden floor, on which a load or cubic yard of sand and gravel could be thoroughly mixed with the lime. The quantity of lime to be added to each cubic yard of the other materials, so as to constitute one-seventh of the entire mass, will be about $2\frac{3}{4}$ bushels. Planks should be placed over the excavation and at a height of at least 6 feet above the floor, others should be laid so that when the materials are thoroughly mixed, they may be immediately wheeled up and dropped from the above height. A board should be placed on edge next the unremoved soil, in order that the concrete may there have a straight square edge. As the filling in of the concrete proceeds, it should be immediately gauged to the proper depth with a straight-

edge, in order that it may have an even surface, which should afterwards be made smooth by beating it evenly with the back of a spade or shovel. This should be done before the concrete has had time to set, for after it does so it ought not to be disturbed. After allowing the concrete to be fairly set, the soil of the next division of the border should be cleared out by turning it upon the concreted portion next the wall; the bottom should be levelled to the proper slope as before. When this has been done, the edging boards should be removed to admit of the complete junction of the concrete about to be laid with that previously done; and after placing them next the soil, the floor of this portion will be ready for the reception of the concrete. When this has been introduced and set, the soil can be levelled in, and that of the third or outside division of the border may be thrown partly on the border and partly on the site of the walk. In finishing this portion the edge of the concrete should not be made square, but rounded off, so as not to be so readily broken.

Instead of concreting the border in portions lengthwise, it may be done in sections right across, provided time is allowed for each to set before being covered with the soil of another. By following the preceding directions a very substantial floor will be the result. It will be impervious to the roots of trees; but it must not be supposed that it will be much warmer than the natural subsoil on which it rests. If this be undrained, and in summer comparatively cold, from the presence of spring water, that cold will be communicated to the concrete or other substance with which such water comes in contact. Where the subsoil is not drained, the concrete rests on a bed of substances, the interstices of which are occupied by water; but drain off the latter and these interstices immediately fill with air. The temperature of the latter is governed by that of the atmosphere with which it is in connection, and the mean temperature of the two will nearly correspond; whereas the water of the undrained substratum maintains nearly the temperature of the springs which constitute its source; so that it is but little affected by the atmospheric changes of temperature. In short, the temperature of the air in a drained substratum, rises in summer nearly in a corresponding degree with that of the atmosphere in which the tree makes its growth above ground, so that both roots and branches

are nearly in the same condition as regards mean temperature. There is, however, no such correspondence when spring water occupies the interstices of the substratum. On the contrary, when the atmospheric heat is such as to stimulate vegetation, the water of the subsoil participates but little in the rise of temperature, and a great discrepancy between the temperatures to which the upper and lower portions of the tree are subjected is the consequence; and such discrepancy cannot fail to produce most injurious effects on the health of the trees. These effects will, however, be sufficiently guarded against if the floor of the border is formed on a drained substratum, from which stagnant water is completely removed, so that air may occupy the interstices.

IV.—SOIL FOR FRUIT-TREE BORDERS.

The soil best adapted for fruit-tree borders in general, is a good substantial loam. For pears and apples it may be rather strong, inclining to clayey loam; but for stone fruits, such as plums, cherries, peaches, nectarines, and apricots, a fine loam inclining to the sandy is preferable. Under particular circumstances of climate and locality, various compositions have, however, been recommended and employed with success. Where the soil is naturally a good fresh loam, trenching will be nearly all that the border will require, under ordinary circumstances, to fit it for the reception of the trees. If, however, first-rate borders are to be formed where the soil is naturally either too poor and sandy, or is, on the other hand, a very strong tenacious clay, the original, in either case, should be removed, and fresh materials introduced. The question is, what these should be? Where the climate will mature shoots of vigorous growth, nothing could be better than turfy maiden loam, as free from iron as possible, such as is used for potting plants. This, however, might not be attainable in many cases, except at a very great expense. Recourse may therefore be had to fibrous turf from a good loamy pasture. In some places, banks of loam occur, which, although dug to a considerable depth, become friable by exposure to the weather; and such, mixed with some of a fibrous nature, may be used. Some persons would be disposed to give the borders a good coat of manure; but this is worse than useless, for in a new and

well-made border, the trees are generally complained of as being too luxuriant and unmanageable; and dung only increases the difficulty of keeping them in proper order. Instead of applying the manure to the border to do harm, it will be better to give it to the field whence the turf may have been taken, for by so doing, the field will be in a great measure compensated for the loss of the turf, especially if the latter be taken and left in alternate strips.

One of the best fruit growers in this country, Mr. Snow, gardener to Earl de Grey, at Swinton Park, is greatly in favour of turf for fruit-tree borders; and certainly his opinion of it is well supported by the splendid productions he obtains. He states (*Gardeners' Chronicle*, 1846, p. 499), that "In using turf, the first outlay is certainly the only one incurred; the turf is cut, carted home, chopped in pieces, put into the border, the trees planted, and all is completed; but in making use of an artificial soil, though you go to work most carefully, who shall say where the expense will end?—the labour consumed in the mixings, turnings, &c., that are requisite, besides the expenditure for such components as I conceive would be required to place it on an equality with turf. If it be objected that the plan of paring a pasture is detrimental, I reply that a man's labour for a day with a plough or spade (according to the quantity), and a few good grass seeds, will speedily make up for the turf, and is not unfrequently the means of re-invigorating and improving the pasture. And now a few words as to the advantages I believe turf to possess over mixed material.

"I do not mean to assert that fruit-trees will not grow in other materials than turf. I have tried various soils and compounds, and some with fair success; but I never by such methods produced crops equal to those grown from turfy matter, either in quantity, size, or flavour. I believe turf procured from a pasture to contain properties adapted to the wants of trees, which artificial substitutes do not possess; and I have always found, that in turf, the trees "fibre" more, ramifying through in all directions. More moderate sized and fruitful wood is also formed. But in borders formed of different materials, the roots are found to be much stronger, but fewer; pushing farther from home, and very often downwards, though perhaps into a cold clay. Trees in this state will be seen to make tremendously strong wood and to be very unwilling to bear fruit.

"The durability of a turf border should also, I think, be a weighty argument in its favour; if properly formed, it will not need renewal for twenty or thirty years. I am aware that many are of opinion that injury is done to a pasture by paring off the turf; but I am of belief that it is mostly to the eye, and that only temporarily; and, surely, nobody who takes a delight in a garden would (even admitting that some slight harm was done) consider it worthy of notice, or think anything too good which was essential; more especially when counterbalanced by the production of good flavoured fruit, which, whether growing or placed on the table, is a source of pride and pleasure to all parties; but reverse the picture, and with fruit not fit to be eaten or looked at, observe the painful feelings of all—the gardener, the great sufferer, although the fault lies beyond his control. To produce good fruit, good means and good materials must be employed; and for fruit borders, my conviction is, that nothing is better than green turf."

We do not suppose that green turf is superior to that which is dried. Indeed, we should not prefer turf with much length of grass upon it, unless the latter were in a withered state at the time; for if green grass ferment near the roots of trees it will kill them. In very many cases, borders cannot be made entirely of fresh soil on account of the expense. Attempts should, however, be made to improve the natural soil as much as possible, with the means at command. If the ground is poor and sandy, manure alone will not produce the permanent improvement which the trees require. A compost of dung and turf, or dung and loam, is preferable; and that this compost may be where it will prove most useful, it should be placed not at the surface, where the roots could not be preserved in cropping; nor at the bottom, where it is not desirable that the roots should be enticed; but about half-way between the top and bottom. If the soil be naturally a too heavy clay, it should be burned and corrected by such means as have been pointed out in treating of soils.

In situations where the climate is not sufficiently warm to ripen the wood which would be produced by trees in borders formed in the manner above directed, great advantages have resulted from mingling stones with the soil of the border. This has been well explained by Mr. Gregor Drummond, gardener to Sir Robert Preston, of Valleyfield, in a memoir

of which an abstract was communicated by the Caledonian Horticultural Society, to the Horticultural Society of London.

A site, near Valleyfield, where glass-works formerly existed, was made that of a cottage and flower-garden; and Mr. Drummond states, in his excellent memoir, that "When the ground was levelled for the garden, it consisted almost entirely of coal-ashes, brick-bats, and lime-rubbish, to which was added about 15 inches of fresh soil, to prepare it for the flowers and shrubs. As it was proposed to plant French pear trees in the borders next to the walls, the fresh soil was there trenched down about 18 inches, and mingled with the rubbish. Another foot of fresh soil was then laid over the whole surface of the border, and the trees planted.

"It was predicted that a border so formed would never answer, but would assuredly canker the roots of the trees; this, however, has not happened. On the contrary, the Crassane, St. Germain, Chaumontel, Colmar, Brown Beurré, Bergamotte de Pâques, and Jargonelle, have all produced fruit the *third* year after they were planted, and have continued to yield excellent crops ever since, far greater than similar trees planted in the deep rich borders of the other gardens. Of these latter trees, many had been planted *twelve* years before they produced any fruit; they grew, however, vigorously, ran greatly to breast-wood, and continued to grow so late in the season, that the flower-buds were frequently but ill-formed, and the young wood imperfectly ripened. The fruit, also, which they produced, was borne chiefly at the ends of the branches, and was frequently hard and gritty at the core. On the other hand, the trees in the cottage garden seem to have acquired a different habit; they did not, indeed, grow so vigorously, and they produced little breast-wood; but they ripened their young wood earlier in the autumn, and fruited more regularly over the whole surface of the tree."

In preparing another border, "as much of the rubbish of old buildings as would form a layer of about 14 inches in thickness, was spread over the whole border. On this was laid a stratum of rich manure, about 6 inches thick; and the whole was then trenched and turned over in such a way as to mingle the rubbish with the soil of the border, but not going so deep as to encroach on the subsoil.

The whole being thus mixed together and made level, was then covered with about a foot of light soil." In the border thus formed, different sorts of pear trees, one year grafted, were planted, and "all these trees showed fruit in the *third* year, and bore a beautiful crop in the *fourth* year after they were planted, and the crops produced every year since have been astonishing. The surface of this border every winter gets a dressing of cow-dung, which is dug in about 8 inches below the surface.

"Another border was similarly prepared by mixing up the rubbish of an old wall with the soil of an old border, to which no dung was added, lest it might make the soil too rich; but this Mr. Drummond has since regretted, as he finds that where stones and rubbish are mixed with the soil, there is no danger in making a free use of manure. The trees in this border came as early into bearing, and continued to be as productive as the trees at the cottage garden.

"By thus mixing stones and rubbish with the soil of the border, and forming the border above the subsoil, we are able to bring French pear trees into a bearing state at a much earlier period of their growth, and to render some varieties of these trees, hitherto considered as shy bearers, not less productive than those of the more common kinds."

Mr. Drummond found, that the roots of trees raised from borders where the soil was mingled with stones and rubbish, presented a dense mass of fibrous rootlets; whilst others, which had grown in deep and rich borders, without such admixture of stony substances, exhibited only long naked roots, more or less destitute of fibrous appendages. "In the rubbish borders, the fibrous rootlets might be seen to seize, as it were, on some substances of the soil in preference to others; pieces of lime-plaster, or mortar, were generally preferred, being often found enveloped in a mass of such rootlets; next to these, pieces of whinstone and brick were selected by the rootlets; coarse gritty sandstone they seemed to reject; but to like the fine white sandstone which the roots of heaths are fond of."

"In connection with this search after stony bodies, Mr. Drummond mentions some curious facts respecting the directions which roots take in borders formed in part of paving stones. If such stones be laid at the bottom of the border, with the view of preventing

the roots striking into the subsoil, the trees will soon send down their roots until they come in contact with the pavement, over the surface of which they will then spread themselves in every direction. Should their extremities not be able to penetrate the mortar or clay in which the stones are embedded, they will, after a time, push out beyond them, and then dipping down, take an inverted position, and extend beneath the pavement. On the other hand, if the stones be laid on the surface of the border, instead of its bottom, the roots then seem to strike upwards, and spread along under the surface of the stones. In both, the stones seem to attract and retain moisture, and, during the vegetating season, the roots strike towards them in order to obtain it; but with this difference in the ultimate result—when the stones are laid at the bottom of the border, the principal roots are detained there, and their fibrous rootlets are more or less destroyed during the winter by the too great moisture to which they are exposed. In such circumstances, the trees grow vigorously, but produce comparatively little fruit, and that of inferior quality; but when the stones are laid on the surface, the principal roots are also formed there; and their fibrous rootlets are thus preserved in a healthy state during the winter. Such trees grow less vigorously than in the former case; but they produce excellent crops of fruit, and that of superior quality.

“As the result of his inquiries and experience, Mr. Drummond recommends the following mode of forming a border, as suitable for every variety of fruit-tree which we are in the custom of raising against walls. He would make the border at least 20 feet wide; it should be composed of $2\frac{1}{2}$ feet in depth of good soil, rather light, with 1 foot of broken whinstone and lime rubbish, and 1 foot of cow and stable dung. These several ingredients should be thoroughly mixed together, and when the whole has been levelled, another foot of fine mould should be spread over the whole surface. The walk he would lay down on the surface of the border at the distance of 10 or 12 feet from the wall; and this should be done in such a manner as that the surface of the border may have a gentle slope from the wall to the walk, and the slope then be continued from the walk to the natural surface of the ground. On no account must the subsoil be disturbed.

“Those who are advocates for the shallow planting of fruit-trees, may suppose the border, recommended as above, too deep, and also too rich, and that it will promote too great luxuriance of growth; but, provided the materials employed favour the production of fibrous rootlets, we can hardly ever make the border too rich. Encouraging such rootlets seems to produce that fertile habit in the tree at an early stage of its growth, which checks any tendency to over-luxuriance afterwards; and to turn the powers of the tree to the formation of flower-buds, and consequent production of fruit. Wall-trees are exposed to a higher temperature and greater evaporation than standards, and require, therefore, a larger body of soil and a more copious supply of moisture for their roots than standards do.”—(*Horticultural Transactions*, 2d series, vol. ii. p. 49.)

The kind of hard materials to be mixed with the soil is not unimportant; for, as Mr. Drummond observes, the roots take to some in preference to others, and to such substances as old mortar or plaster more especially. This is most probably owing to these substances being slower conductors of heat than those that are of a silicious nature. From some experiments made by Dr. Tyndall, with reference to the conduction of heat, and which are detailed in the *Philosophical Magazine*, 4th series, vol. vi. p. 121, it appears that the conductive power of rock-crystal (pure silica) was 90° , and that of gypsum 19° , or, in other words, that silica conducts nearly five times quicker than gypsum. Impure silica, as it exists in flint, sand, or silicious rock, will probably not conduct so rapidly as the pure crystal; but if in these states the power of conducting heat should be only three or four times that of gypsum, still the difference is remarkably in favour of the steadiness of temperature which gypsum maintains, compared with silicious substances. Its conductive power, Dr. Tyndall remarks, is scarcely superior to that of wood, while there is the strongest experimental grounds for the belief that silica possesses a higher conductive power than some of the metals. As a general rule, it is admitted, that sudden changes of temperature are prejudicial to animal and vegetable health, and hence the roots of plants prefer contact with those substances which maintain the most uniform temperature. Gypsum, as appears from what has been stated, being one of those

substances possessing that property in a high degree, should be introduced in borders where the climate is cold and variable. Old plaster, for example, can in some cases be had in abundance; it of course will best answer the purpose if broken scarcely so small as stones for rubble drains. Lime compounds are slow conductors; therefore pieces of old mortar and chalk lumps may be used. Charcoal, which acts likewise as a manure, is one of the best non-conductors; hence it answers well for the drainage of pot plants, but would be too expensive for borders. Coal ashes and scoria are much of the same nature in this respect; but their sharp angular surfaces are too cutting for the roots, and are apt to induce canker. Brick-bats, especially from bricks made near London, consist of a considerable quantity of carbonaceous matter, derived from the small coal mixed with the clay, and although exposed in a cold day with flint stones, till they ultimately acquire the same temperature as the latter, yet they do not feel by any means so cold to the touch, because they acquire and give out heat but slowly. They are, therefore, ranked among what are termed *warm* materials, and are very suitable for mixing with the soil of a border requiring to be formed of such materials.

We have now endeavoured to point out the principles, and to detail the modes of making fruit-tree borders according to different circumstances of soil, subsoil, and climate. Where all these are favourable, proper trenching and levelling are only necessary. If the subsoil is bad, or cold and wet, its contact with the roots should be cut off by an impervious and somewhat elevated floor; if the soil is indifferent, it should be ameliorated as much as possible; if bad, it should be entirely removed, and better substituted. Where the climate is at fault, it is advisable to use rather light soil, mixed with stones and other hard substances. There are, however, without doubt, very many cases where borders could not, on account of expense, be made so effectually as we have recommended. In these cases the borders should not be deeply trenched, if, by so doing, the principal roots would be encouraged to occupy a position unfavourable to the health of the trees. It will be better to depend on keeping the roots near the surface, and there feeding them by means of a well prepared compost of dung, and the most suitable kinds of soil that can be obtained, as will be explained when

we come to treat of the planting and subsequent management of the respective kinds of fruit-trees.

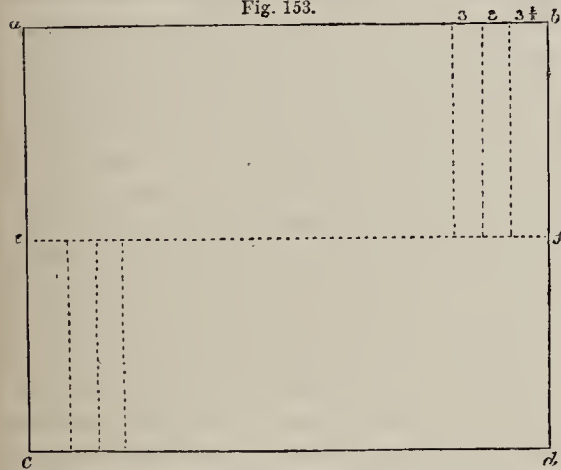
V.—PREPARATION OF THE GROUND.

The formation of the borders having been completed, the preparation of the rest of the ground may be proceeded with. Where the surface is level or of the proper slope, and the soil naturally good and of the sufficient depth, merely trenching it over in the usual way renders it fit for laying out and cropping. Where the ground is, on the contrary, irregular, and the undulations of the subsoil, not corresponding with those of the surface, render the soil of unequal depth—or where soil has to be wheeled or carted from one part of the ground to another, or introduced from the outside—the operations become complicated, and various preliminary considerations are necessary, in order that the work may be commenced at the proper place, carried on with regularity, and in the best and most economical way. It is presumed that the level or slope of the ground has been previously determined, as recommended in the section on levelling. The depth of soil should also be ascertained. By digging down to the subsoil at a number of points, adding together the depths, and dividing by their number, the mean depth of the soil will be found. At the same time, the depth at which the subsoil lies below the proposed surface level, at the different points, should be marked on a plan. By these means we come to the knowledge of the present position of the subsoil, and also that which it should be made to occupy. If the surface is to be made level, and if the soil is to be of uniform depth, then the substratum must also be made level, or preferably with a slight declivity towards drainage. If the surface is intended to have a regular slope, the substratum ought to have a corresponding one. In either case it is evident, that attention should be first directed to the levelling of the bottom. When a trench is turned out to the depth of all the good soil, its bottom most probably will be very irregular; it may be altogether too high or too low, or portions only may be too high, whilst others are the contrary; but before the soil of the next trench is moved, the bottom of the preceding should be made up or taken down, as the case may be, to the proper level. In order to do this with the least amount of labour,

the trenches ought to run across where the subsoil is in one part of their extent too low, and in another part too high, so that in taking down the latter, we may, at the same time, use the materials to make up the portion of the trench that is too low. It may not be convenient or possible in all cases to run the trenches so that the high portion will be exactly sufficient to fill up that which is too low; but this should be kept in view as much as possible. It should be a rule, that before a too high part is moved, a trench should be opened where the ground is too low. The work should be commenced in the lowest part of the ground, taking care, however, to leave roadways for carting materials if necessary.

In trenching ground that naturally lies on the desired level or slope, the ordinary mode of turning over trench after trench, each about 3 feet wide, may be adopted. In this case, the ground should be divided into convenient portions, one of which is represented by *a b c d* (Fig. 153). If the first trench were opened

Fig. 153.



out the whole breadth of the piece, as from *b* to *d*, the soil taken out of it would have to be wheeled to *a c*; but instead of doing so, it is better to divide the ground equally by a line from *e* to *f*. Then take out the opening across the end of one of the halves, as from *b* to *f*, and lay the soil on the adjacent end of the other half, as from *f* to *d*. If the soil can be laid outside the limits of the piece marked out, so much the better. When the operation reaches *a e*, there will be an open trench there, which is to be filled by the soil taken out of the first trench of the other half, as from *e* to *c*. The work is continued till the whole of the second half is trenched over, the last trench at *f d* being filled by the soil placed there, from the first trench *b f*. It will be observed,

on referring to the figure, that the first trench *b f* is marked off $3\frac{1}{2}$ feet wide; whilst the others are only 3 feet wide. This is in order to allow for the slope necessary to prevent the loose soil from falling back into the bottom of the trenches; for these should be fully 3 feet wide at bottom, to make sure that no ridges are left unturned between the trenches, and this being the case, each open trench must be more than 3 feet wide at top, or both its sides must be perpendicular; that next the solid ground may, and indeed should, be as perpendicular as possible, but the loose soil on the opposite side must have a slope, for the reason above stated. The trench at *e c* should be equal in width to the one first opened at *b f*.

Where the ground is very uneven, and where the bottom has to be raised or lowered to a considerable extent in certain parts, the trenches should be more than 3 feet wide. According to the amount of elevation or depression required, the width of the trenches may be 4, 5, or even 6 feet. The latter is not too much in cases where the subsoil may have to be made up as high as the original surface level of the ground, or say 3 feet. Where deep hollows have to be made up, it may be advisable to do so according to circumstances, in portions from 6 to 12 feet wide.

Hitherto we have chiefly directed attention to bringing the substratum to the proper level, and if this be done, the good soil will rest on an even bottom. As already observed, the depth of the soil will probably vary, but if its mean depth in each trench correspond with that of the whole piece, then in trenching it can be taken from where it is deeper than the average, and wheeled along the firm side to where it is too shallow. In general it will, however, be found best to throw up the soil at the place where an extra depth occurs, and then to regulate the surface after the whole of the ground, including even the site of the walks, shall have been trenched. We shall then have an even surface, and an equal depth of soil, on an evenly formed substratum. If additional soil be required, and can be afforded, it may be introduced as the trenching proceeds; and the same may be said as regards manure. The latter should be put down about half way between the top and bottom, and a good layer of dung should also be dug or ridged in near the surface of the ground, after the latter has been levelled, especially if much fresh loam has been turned up. Although it is desirable

to obtain a depth of 3 feet of soil for a kitchen garden, and although the ground should be loosened to that depth, yet it may not, in some cases, be advisable to turn the lower part of the trench uppermost. If there be 18 inches deep of black soil, and as much of good loam beneath, the whole may be turned upside down; but if the black soil is shallow, or if the bottom part of the trench is a clayey loam, it will be advisable merely to loosen a spade's depth of the bottom of the trench, and so leave it to be gradually brought up, a little at a time, at subsequent trenchings.

VI.—WALKS.

There is much diversity of opinion with regard to the laying out of walks in pleasure grounds; their number, divergence, and curves, are all matters of taste. In the fruit and kitchen garden, however, utility ought to be the leading principle; but without interfering too much with this, regularity should be kept in view as much as possible.

With regard to the number and direction of the walks in a kitchen garden, the necessity of one all round, so as to leave a border of greater or less breadth between it and the walls, is universally admitted; and two intersecting each other in the centre of the garden are found convenient. This arrangement of surrounding walks consisting of two side and two ends ones, and two cross ones, is very generally adopted. Besides these six principal walks, two or more subordinate ones, as represented in Fig. 102, may be necessary; but the number and direction depends upon the extent and form of the ground. The walks should of course run parallel to the walls. Their distance from the latter must be determined according to circumstances. It was formerly a rule to make the walks at a distance from the wall equal to the height of the latter, so that if the wall should be 8 feet high, the border between it and the walk would only be 8 feet wide; but after deducting say 3 feet for a path, and small border close to the foot of the wall, there is only 5 feet left, which is a very narrow strip for vegetables; and yet to prepare and crop it would require nearly as much time as a broader one would. Supposing that the walls are 12 feet high, and that the inclosed area consists of 2 acres or more, the distance of the walks from the walls may be 18 feet. If

the wall on the south side is lower than elsewhere, as is frequently the case, the walk next it may be 12 feet distant. Where the area is between 1 and 2 acres, the walk in front of the south aspect wall may be still 18 feet distant, and that by the north aspect wall 12 feet; but the others on the east and west sides, 15 feet. In gardens of about 1 acre, the distance of the walk from the south aspect wall may be 15 feet, and from all the other walls the distance of the walks may be only 12 feet, in order that the ground to be laid out in quarters may not be too much reduced. For the same reason, in very small gardens the walks may run within 3 or 4 feet of the east, west, and north aspects; but still retaining, if possible, a width of not less than 12 feet for the south aspect border, partly on account of the trees on that aspect, and partly because the border, from its south exposure, is so useful for various early crops. The width of the walks should likewise bear some proportion to the extent of the garden. In pleasure grounds, we are aware that the breadth of walks should be regulated by their length, or at least by the portion of it that comes within view at one time; but this principle cannot be so strictly followed in gardens where utility is the main consideration. The space occupied by the walks cannot, however, be considered as lost, except for the purpose of walking on, for there is no objection to the walks being made within the limits of the prepared border; and when this is done, the roots of trees will feed as well beneath them as elsewhere. Indeed, if there were no walks, a row of fruit-trees would require a clear space on each side of them equal, or nearly so, to that which we should recommend for a walk. For small gardens, we should say, that the surrounding walks should not be less than 5 feet, and the cross walks 6 feet wide. The reason for the latter being wider than the others is, in order that there may be a more free circulation, and that the rows of espalier trees, which it is presumed will be planted on each side of these cross walks, may be farther separated. If the walled-in area is between 1 and 2 acres, the surrounding walks should not be less than 6 feet wide, and the cross walks 7 feet. In gardens of the extent of 2 or 3 acres, the surrounding walks should, we think, be 7 feet wide, and to admit of manure, &c., being conveniently carted along the cross walks, it would be well to make them 8 or 9

feet wide, with a circle, where they intersect, large enough to admit of a horse and cart turning round it. In gardens of more than 3 acres, the cross walks might be at least 10 feet wide, the others 8 feet. The above widths are greater than usually recommended, but if the ground is not very limited, walks, which by some persons would be considered too broad, are preferable to those that, for the sake of occupying but little ground, are made decidedly too narrow for admitting of a free circulation of air.

The width of the walk having been determined on, the next step is to fix upon its level with reference to the general level of the ground. If the level of the borders correspond with this, or nearly so, the edges of the walks may be made a little lower, but so that the middle or crown of the walk, may be a little higher than that level. Where the borders have been raised considerably, the edges of the walk may be raised as high as the general level of the ground. The lines of the edgings having been marked by a small stake driven at each end of them, so that the tops of the stakes shall also mark the proposed height of the edging, the soil should be well trodden or otherwise made compact, then, by means of levelling rods, a number of points should be made on the same level, or inclined plane, as the tops of the stakes at each end. The ground between the different points having been made even, a line should be stretched about an inch from the line of edging towards the walk; and along this line a cut should be made with the spade, as a guide for the excavation of the soil to be removed, in order to admit of the bottoming materials. When the soil is taken out to the proper depth, the line should be again stretched so as to mark exactly the line of edging, and the inch of soil cut off straight by the line. Box, which is the best kind of live edging, may then be laid. The depth of the excavation should be such as to hold enough of materials to constitute a walk substantial enough for wheeling upon. Except the garden be very small, the cross walks should be made to bear carting; and in large gardens all the walks should be strong enough for any traffic of that kind that may occasionally be required. The excavation for materials to bear carting, should be about 9 inches deep from the level of the edging, and where the heaviest traffic is wheeling, 6 inches will be sufficient. It is a question whether the bot-

tom of the walk should be dug out level, convex, or concave. Some recommend the bottom to be made deepest in the middle, the hard materials forming there a sort of rubble drain; others lay a drain pipe; but in either case, the worms are apt to stop the drainage. The moisture collected encourages the worms to work completely under the walk, as indeed is the case where the bottom is made level. The best plan is to give the bottom a curved form like that of the surface of the walks, in order that the water may fall to both sides, where the well-drained trenched ground will always be in condition to receive it. In wet climates, drains in the middle or at each side of the walk may be necessary, but in localities where the annual fall of rain does not exceed 28 inches, all the water that sinks from the walk into the adjoining soil will prove highly beneficial to the trees, and in many cases will save the labour of watering. From the consideration of these circumstances, we would recommend the bottom of walks to be curved, well beaten, and rolled firm.

Various materials may be used for the bottoming of walks, such as stones, flints, brick-bats, clinks, lumps of hard lime, rubbish, burned clay, &c.—in short, any hard substance that contains nothing pernicious to vegetation may be employed. Granite, broken like that for macadamized roads, is perhaps of all others the most substantial. Nine inches thick of this, with 2 inches of rather coarse, and 1 of fine binding gravel at top, will form an excellent walk, such as cannot probably be surpassed for a kitchen garden. Indeed, 6 inches of broken granite and 3 inches of gravel, will make a good substantial walk. Fine binding gravel for the surface is not easily obtained in some parts, and accordingly various substitutes have been more or less successfully tried. Sand, by proper management, may be made to answer very well. A very thin layer of it should be put on, and it will gradually mix with substances that will render it tolerably adhesive. Another layer may then be sprinkled or sifted upon the previous one. Road-sand loosens exceedingly after frost, so as to render walks made with it unfit either for walking or wheeling upon for a considerable time. Decomposed sandstone answers tolerably well. Coal-tar and sand is very unsightly, and if not very thick, is liable to break when wheeled upon in cold weather; the tar melts, and has a very disagreeable smell, in hot weather; and

it is, moreover, dangerous for the roots of trees. Its use for garden walks should therefore be avoided. When we take into consideration the cost of gravel walks in the first instance, and the subsequent expense of rolling, weeding, turning, and occasional renewing, it is questionable whether stone paving would not prove cheaper than gravel in the long run. A quantity of rough and fine gravel equal to a cubic yard or load may cost about 8s. Allowing that the materials were laid on 9 inches thick, the load would make 4 square yards of walk, costing thus 2s. per superficial yard. Paving may be done for 6d. per square foot, or 4s. 6d. per yard. It is therefore little more than double the price of gravel, and of the paving it may be said, that the first expense is the last. This, however, is not the case with gravel. In the course of a few years small weeds, such as *Sagina procumbens*, and mosses, generally take such possession of the surface, that the expense of many days' labour is every year incurred in endeavouring to eradicate them. It is impossible to say how much this tedious process may cost, but it requires to be done at a period of the year when such fruitless labour can ill be spared.

Although we are by no means favourable to the use of coal-tar compositions for garden walks, yet there are others, in which lime is the cementing substance, that may be advantageously employed. One of these appears to be well deserving of notice. The method of forming it is stated by Mr. E. Mehan, St. Clare, Isle of Wight, to be as follows:—

"To about 3 bushels of coal-ashes, previously passed through a coarse sieve, or fine screen, are added one of gray lime, and one of fine gravel. Water is applied till the whole is of the consistency of mortar. This composition is then spread 3 inches thick over the walks prepared for it, and made smooth and even with a flat piece of board or a trowel. In a few days it will become hard. The walks are prepared with rough gravel—the coarse screening of that used with the coal ashes. To this I might add that the only necessary precautions to obtain a hard and dry walk, are to break the lime small before it is mixed, and to raise the centre of the walk an inch or so above the sides."—(*Gardeners' Chronicle*, 1848, p. 685.)

The depth and nature of the materials are usually suggested with respect to drainage. They may answer that purpose for a few years,

but we do not suppose that even broken granite would long continue porous in a garden walk. The spaces between the stones must soon get filled up by the earthy matters introduced partly by worms, and partly by particles of soil carried down by the rain from the surface, however clean this may be kept. Probably the best mode of maintaining the porosity of the bottoming of the walk, would be to fill the interstices of the coarser materials as closely as possible with sand, which would prevent, to a considerable extent, the introduction of other matters of an unctuous, muddy, or adhesive nature. But ultimately sand-filters—and such the above arrangement would be—get clogged, and do not act; and we find that after a walk has been used for some time, and has, by good keeping and frequent rolling, acquired a smooth compact surface, the rain chiefly, or almost entirely runs off by the surface. The porosity of the drainage is useful until such time as the walk can be brought to this smooth compact state; but afterwards it is of little or no consequence, the hard materials are then only useful for solidity, a sufficient degree of which is essential for a walk, in order that it may bear heavy traffic without yielding, or exhibiting inequalities of surface. On this account we have recommended a good depth of hard materials—more perhaps than can well be afforded in some cases. To meet limited means, we may state that a very fair walk may be made with a considerably less quantity of materials than would be required to form a walk in the manner above recommended. Let the bottom of the walk be taken out to the depth of only a few inches; but let it be curved, beaten, and rolled, so as to appear as regular as the surface ought to be, and it should form a similar curve. The surface may be regular; but if the bottom be irregular, the former will, in consequence, become uneven. In places where the bottom is too high, the coating of gravel will be thin, and where this is the case, a sinking of the surface will take place. A walk with a uniform thickness of, say 3 inches of gravel, will retain a more even surface than one with the gravel 3 inches deep in some places, and 6 inches deep in others. Therefore, it is necessary that great care should be taken to make the bottom very regular, otherwise expense is incurred for materials which are worse than useless. When the bottom is prepared, a layer of lime rubbish or any other

hard materials that can be most readily obtained at the least expense, should be spread very equally over the bottom, and well rolled. If there be any hollows, they should be made up and the roller again passed over, after which it is presumed that the surface will appear nearly as even as that of a finished walk. A coat of gravel should then be laid on to the thickness of 2 or 3 inches, treading, raking, and rolling it, before it gets dry. Stones collected from among the gravel by the rake, should not be buried in patches immediately below the surface. They should either be distributed equally and beaten into the bed on which the top gravel is laid, or entirely removed, in order to be laid quite at the bottom with the other rough materials. If thus carefully made in the first instance, and afterwards well kept, a good walk for not very heavy traffic may be formed, with a few inches thick of gravel. If there should occasionally be much wheeling upon it, planks could be used. By rolling into the surface a very thin coating of fine gravel every two years or so, the walk will become more and more solid.

Curve of Walks.—That gravel walks have not a good appearance when they have too great a rise in the middle, and that such walks are inconvenient for walking upon, will be readily admitted. What the proper rise should be, is a question upon which authorities widely differ. Some recommend the middle to be 1 inch, others 2, 3, or more inches, higher than the sides. But in stating the rise, the width of the walk ought to be taken into account, otherwise great mistakes may be made. For example, a walk 10 feet wide may have a rise of 2 inches from the sides to the middle, and this we think is one that will prove satisfactory; but in the case of walks only 4 feet wide, a rise of 2 inches would make the surface more like a ridge than most people would suppose. It would be like walking along a cylinder of 12 feet radius. After careful observations on walks, and from experience of those with high, and of others with low curves, in various situations, we venture to recommend that the rise of the middle above the sides should be 2 inches for a walk 10 feet wide, and so on in proportion for other widths. This ratio is, in our opinion, the best. In the following table, the height of the middle of the walk above the sides is calculated at the rate of $\frac{1}{10}$ ths of an inch rise for every foot, reckoning from the middle of the

walk to the side. Thus, in a 10-feet walk, the distance from the middle to the edge being 5 feet, $\frac{1}{10}$ inch per foot on that distance amounts to 2 inches. Adopting this ratio, half the width of a 15-feet walk being $7\frac{1}{2}$ feet, a rise of 3 inches is accordingly allowed; or, we may otherwise calculate the rise at $\frac{2}{10}$ inch for every foot which the walk has in breadth, or take $\frac{1}{50}$ th part of the whole breadth of the walk.

Breadth of Walk.		Elevation of Middle above the Sides.		Radius of Curve.	
Fest.	Inches.	Ft.	Ins.		
4	$\frac{8}{10}$	30	0.4		
5	1	37	6.5		
6	$1\frac{2}{10}$	45	0.6		
7	$1\frac{4}{10}$	52	6.7		
8	$1\frac{6}{10}$	60	0.8		
9	$1\frac{8}{10}$	67	6.9		
10	2	75	1		
11	$2\frac{2}{10}$	82	7.1		
12	$2\frac{4}{10}$	90	1.2		
13	$2\frac{6}{10}$	97	7.3		
14	$2\frac{8}{10}$	105	1.4		
15	3	112	7.5		
16	$3\frac{2}{10}$	120	1.6		

The centre of the walk may be of the proper height above the edges; but if the gravel be laid on so as not to form a regular curve between the two edgings, the work is imperfect. It is frequently made too full for some distance on each side of the middle, and then sloping rapidly to the edges. In this case, the middle of the walk must be nearly flat, and instead of one curve, the surface is formed almost into a flat and two slopes. In order that the water falling on the walk may have a regular descent, the curve of the surface should correspond with the arc of a circle. To insure this, the best plan is to take a board and cut out the curve, which the radius given opposite the breadth of the walk in the above table, would form. With this curve, the walk, when finished, should exactly correspond. In fact, unless it do so, it cannot be considered perfectly finished, either as regards appearance or utility. With respect to appearance, the eye will detect irregularities and interruptions in a curve which evidently ought to be a uniform one; and with regard to utility, the more correct the curve, the greater will be the facility with which water will flow over it, and, consequently, the sooner the walks will be again dry after rain. It is better to have a moderate rise with a regular curve, than a great one with an irregular curve, flat, or almost flat, in some places, and too steep in

others. We have seen walks having no greater curve than that above recommended, perhaps not so much, until within a foot or so of their edging, where they form a slope that no human being could walk upon with any degree of comfort. From what has been stated, we think it will be readily admitted, that for the sake of appearance, utility, and comfort, care should be taken to give walks a correct curve. This may easily be done in the way we have pointed out, and at no additional expense; consequently, there is no reason why the surface of walks should be formed on a bad principle, or on no principle whatever, when important advantages resulting from the contrary, may be secured by a little trouble, and by attention to the preceding directions.

Edgings for Fruit and Kitchen Garden Walks.—The principal use of an edging is to mark the limits of the walk; for no walk, however well formed, has a good appearance if it merge into the ground on each side. Some line of distinction is therefore necessary. Amongst the various plants which have been proposed for edgings, the box, so long employed for the purpose, still unquestionably maintains the pre-eminence. In small gardens, such things as parsley, thyme, strawberries, &c., are sometimes employed; but none of them forms a neat, compact edging, like the box, nor can they be made to show like it a line no stronger than merely to appear distinctly from end to end of the walk. Live edgings are all more or less objectionable on account of their harbouring slugs and vermin. A box edging, however, can be kept within such small limits that it affords but little shelter for anything hurtful to vegetation. Various plants may be very appropriately used for edgings in flower gardens and pleasure grounds; but for edgings in the fruit and kitchen garden, no plant is so well adapted as the box. It will thrive in most situations where the soil is drained, as that of a garden ought to be. If the situation be damp, and the soil naturally heavy, lime rubbish should be put in the bottom of the walk, so that the roots of the box may reach it. Care should be taken to keep the edging clear from the leaves of vegetables, and especially from decaying leaves.

Sometimes, in order to avoid the trouble and expense of clipping and relaying box or other live edgings, and sometimes as a matter of taste, various hard materials, such as stone, brick, tile, slate, cement, wood, or iron, are

employed for edgings. The materials, forms, and comparative merits of such edgings, will, however, be more conveniently considered at another place. From what has been stated, it appears that the walks in a fruit and kitchen garden should run in straight lines; that they should be of equal breadth throughout their length; that they should be made so as to bear the greatest weight that may be brought upon them in ordinary circumstances; that their surface, from end to end, should be perfectly level or uniformly sloping; that the elevation of the middle above the sides should be sufficiently great to insure dryness, but no greater than will allow of comfort in walking; and, lastly, that the limits of the walk and the soil should be marked by means of an edging.

CHAPTER X.

CULTIVATION OF KITCHEN GARDEN PLANTS.

Having shown how the ground selected for the fruit and kitchen garden should be prepared for the reception of the plants to be grown in it, we shall now give the cultivation of these. In doing so, we shall adopt the alphabetical arrangement, because it is simple, and the most convenient for reference. We are aware that in adopting this arrangement, we depart from the practice of most of our predecessors, they having generally sought a classification founded on the uses of the plants, or on the part made use of. But whichever of these circumstances be adopted as the basis of a classification, difficulties have to be encountered; for the same plant may be used for different purposes, and several parts of a plant are not unfrequently made use of; consequently, in such cases, a vegetable may belong to two or three different classes. Again, some have arranged kitchen garden plants by their natural orders. For the convenience of those who prefer this mode of arrangement, we subjoin a list of the plants treated of in this chapter, arranged according to the natural orders of Lindley and De Candolle:—

FUNGI, D. C.; *FUNGAL, Lind.
Morel.
Mushroom.
Truffle.

* Alliance.

LILIACEÆ, D. C.; LILIACEÆ, Lind.

Asparagus.
Chive.
Garlic.
Leek.
Onion.
Rocamboles.
Shallot.

DIOSCOREÆ, D. C.; DIOSCOREACEÆ, Lind.

Dioscorea Batatas.

URTICÆ, D. C.; CANNABINACEÆ, Lind.

Hop.

POLYGOÑÆ, D. C.; POLYGONACEÆ, Lind.

Patience.
Rhubarb.
Sorrel.

CHENOPODEÆ, D. C.; CHENOPODIACEÆ, Lind.

Beet.

Orach.

Quinoa.

Spinach.

PLANTAGINEÆ, D. C.; PLANTAGINACEÆ, Lind.

Buckshorn Plantain.

LABIATÆ, D. C.; LAMIACEÆ, Lind.

Balm.

Basil.

Clary.

Horehound.

Hyssop.

Lavender.

Margoram.

Mint.

Rosemary.

Sage.

Savory.

Thyme.

SOLANÆÆ, D. C.; SOLANACEÆ, Lind.

Capsicum.

Egg Plant.

Potato.

Tobacco.

Tomato.

BORAGINEÆ, D. C.; BORAGINACEÆ, Lind.

Borage.

CAMPANULACEÆ, D. C.; CAMPANULACEÆ, Lind.

Rampion.

COMPOSITEÆ, D. C.; ASTERACEÆ, Lind.

Artichoke.

Cardoon.

Chamomile.

Chicory.

Costmary.

Dandelion.

Elecampane.

Endive.

Jerusalem Artichoke.

Lettuce.

Marigold.

Picridium vulgare.

Salsafy.

Scorzonera.

Tansy.

Tarragon.

Wormwood.

VALERIANÆÆ, D. C.; VALERIANACEÆ, Lind.

Corn Salad.

Fedia Cornucopiæ.

UMBELLIFERÆ, D. C.; APIACEÆ, Lind.

Alexanders.

Angelica.

Aniseed.

Caraway.

Carrot.

Celery.

Chervil.

Coriander.

Dill.

Fennel.

Parsley.

Parsnip.

Samphire.

Skirret.

Sweet Cicely.

RANUNCULACEÆ, D. C.; RANUNCULACEÆ, Lind.

Nigella sativa.

CRUCIFERÆ, D. C.; BRASSICACEÆ, Lind.

Borecole.

Broccoli.

Brussels Sprouts.

Cabbage.

Cauliflower.

Cress, American.

Cress, Common.

Cress, Water.

Horse-radish.

Mustard.

Radish.

Rape.

Savoy.

Scurvy Grass.

Sea-kale.

Turnip.

OXALIDEÆ, D. C.; OXALIDACEÆ, Lind.

Oxalis Deppei.

Oxalis crenata.

Wood Sorrel.

TROPEOLEÆ, D. C.; TROPEOLACEÆ, Lind.

Nasturtium, or Indian Cress.

Tropæolum tuberosum.

RUTACEÆ, D. C.; RUTACEÆ, Lind.

Rue.

PORTULACEÆ, D. C.; PORTULACEÆ, Lind.

Purslane.

FICOIDEÆ, D. C.; TETRAGONIACEÆ, Lind.

New Zealand Spinach.

CUCURBITACEÆ, D. C.; CUCURBITACEÆ, Lind.

Cucumber.

Gourd.

ONAGRARIÆÆ, D. C.; ONAGRACEÆ, Lind.

Tree-Primrose.

ROSACEÆ, D. C.; SANGUISORBACEÆ, Lind.

Burnet.

LEGUMINOSÆ, D. C.; FABACEÆ, Lind.

Bean.

Chickpea.

Kidney-bean.

Lentil.

Liquorice.

Pea.

ALECOST. See COSTMARY.

ALEXANDERS (*Smyrniū Olusatrum*, L.—
Pentandria Digynia, L.; Umbellifere, D. C.;

Apiaceæ, Lind.), a biennial plant, a native of Britain, was formerly cultivated for its leaf-stalks, which, having a pleasant aromatic flavour, were blanched and used instead of celery. The leaves were likewise employed in flavouring soups. It is now, however, seldom if ever cultivated, celery having taken its place. Sow in March.

ANGELICA (*Archangelica officinalis*, Hoffm.; *Angelica Archangelica*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceæ, Lind.) is a biennial plant, a native of England and the north of Europe.

The tender stems, stalks, and mid-ribs of the leaves are candied with sugar, for which purpose considerable quantities are grown near London. The seeds are occasionally used in flavouring spirituous liquors; and in some parts of the north of Europe, according to Bosc, the leaves and stalks are used as a vegetable, either raw or cooked together with fish or flesh.

Angelica grows well in any good soil, but succeeds best in cool moist situations, such as the banks of ditches.

It is raised from seed, which should be sown in August, or as soon as it is ripe, covering lightly with mould. The seed-bed should be frequently watered, as also the young plants when they come up. These are allowed to remain in the seed-bed till the following March, by which time they will have attained sufficient strength for being transplanted.

The plants may be planted 2 feet apart each way; afterwards the ground should be occasionally hoed, and in dry weather, plenty of water should be given. The stalks will be fit for use in May or June of the following year, when the stems should be cut down. This should be repeated every year about that time in order to prevent the plants from running to seed, for if allowed to do so, their roots would soon afterwards perish; whereas if cut down annually before flowering, Angelica, though a biennial, will then live for three years.

ANISE, or Aniseed (*Pimpinella Anisum*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceæ, Lind.)—is an annual plant, a native of Egypt. It is cultivated in the Levant and in Spain for the seeds, which are employed in confectionary, in distillation, and for the manufacture of a well-known cordial. Medicinally, the seeds are carminative. The summers of this country are seldom sufficiently

warm to ripen the seeds perfectly, but the plant is sometimes grown for its leaves, which are used for garnishing, and occasionally as a seasoning.

It requires a light soil and warm situation, where it may be sown in the beginning of April, in drills 6 inches apart. Thin the young plants to about 3 inches apart; no further care is necessary, except watering in dry weather and keeping the ground clean. The seeds ripen in August or September, if the season is warm.

ARTICHOKE (*Cynara Scolymus*, L.—Syngenesia Polygamia Æqualis, L.; Compositæ, D. C.; Asteraceæ, Lind.)—This is a hardy perennial plant, a native of the south of Europe. It is cultivated for the immature flower-heads, of which the fleshy receptacle, commonly called the *bottom*, and the base of the involueral scales, are the parts used. Sometimes, also, the central leaves of plants in old plantations about to be destroyed are blanched, and the *chard*, as it is then called, is used like cardoons.

The varieties cultivated in this country are:—

1. GLOBE ARTICHOKE.
2. GREEN, COMMON, or FRENCH ARTICHOKE.
3. PURPLE ARTICHOKE.

The Globe, or Large Round-headed artichoke, has dull purplish heads, with scales turned in at the top. It is the sort most esteemed for cultivation in this country. The second sort has a conical or ovate head, with scales pointed and turned outwards. The Purple artichoke has a medium sized head; the scales are pointed, green at the base, but tinged with purplish red on the outside towards the extremities. It is earlier than the preceding sorts. In France, it is considered excellent *à la poivrade*, but not so good cooked.

Several other varieties are described by French authors. The one most esteemed and most cultivated at Paris, is the Large Green or Laon artichoke (*Artichaut gros vert ou de Laon*). It grows larger than the Common Green. The *Gros Camus de Bretagne* has a large, rather flat head, of a pale green colour, and is somewhat earlier than the preceding, but is not so fleshy. The *Rouge* and the *Sucré de Gènes*, cultivated in the south of France, do not prove suitable for the climate of Paris; and that being the case, their introduction into this country would probably be attended with little or no advantage.

The artichoke prefers a deep free soil, such as a sandy loam, and an open situation. The ground where it is intended to be grown should be well manured with stable dung, and trenched 2 feet deep. Sea-weed is also an excellent manure for artichokes, and the application of salt is likewise very beneficial.

The plant is propagated by suckers, of which from six to twelve are usually produced by each plant. In the month of April, or as soon as the leaves are 8 or 10 inches in length, the old stools are uncovered to the origin of the suckers, which are then slipped off with a heel, two or three of the finest being allowed to remain on the parent plant. The strongest of those taken off, and such as have already formed some roots, are chosen for the new plantation; and they are prepared for planting by cutting off any rugged parts at the heel, and removing withered leaves. The suckers may then be planted 8 or 9 inches apart, in clumps of three, placed 2 feet from each other, in rows 4 feet asunder. The sets should be planted about 4 inches deep in holes made by a dibble or trowel, and the soil pressed round them. Water should be given at planting, and subsequently in dry weather till the plants begin to shoot. Afterwards the ground ought to be loosened by the hoe, and this operation ought to be repeated several times in the course of the summer and autumn. In the autumn of the year of planting, some heads fit for use will be produced. If the heads are required for pickling, they should be gathered when about 2 inches in diameter; if for the bottoms, when they are nearly full-grown and before the opening of the scales. As soon as the crop from each of the flower-stems is gathered they should be cut down; and all dead leaves should be removed at the same time. Any heads remaining in November may be preserved for a long time, by cutting them off with the whole of the stalk attached, planting the latter in moist sand in a shed or cellar, secure from frost, and cutting off every three or four days a small portion from the lower part of the stalk.

Towards the end of November, or before frost sets in, the long leaves must be cut off to within a foot of the ground, which should then be dug; but in doing this, care must be taken not to injure the roots. After the ground has been dug, a good thickness of dry litter, fern, leaves, or other protecting materials, should be packed closely round the plants,

but not over their heads. When frost sets in the plants should be well covered over head, but the covering must be removed whenever the weather is mild, and again replaced at the approach of frost. Towards the end of March, or as soon as all danger of severe frost is over, the protecting materials may be entirely removed; but if any of the plants have been partially blanched, as is not unfrequently the case, they should only be gradually uncovered, and exposed to the light. Afterwards, when the leaves are 8 or 10 inches in length, the stools should be uncovered; and all the suckers, with the exception of two or three of the most vigorous, having been removed, the earth should be again replaced round the plants. This having been done, the ground may be dug or forked, and, with the exception of keeping it free of weeds, nothing further is required till the plants come into bearing, which will be the case in June or July.

In the south of France, and particularly in the neighbourhood of Montpellier, when the heads have attained about the third of their full size, the flower-stalk is split through at about 6 inches below the head, and a piece of wood passed through from side to side, so as to keep the two halves of the stalk separate. By this means a considerable increase in the size of the fleshy portion of the head is said to be obtained. We have tried this practice, but very little, if any increase in size was perceptible. Every year, as the crop is gathered, the flower-stems should be cut down, as previously indicated; and the same treatment with respect to protection from frost, removing suckers, digging the ground, &c., should be pursued. After the second year, however, a quantity of well decomposed dung or sea-weed ought to be dug in before winter. Notwithstanding the care taken in protecting the plants in winter, they are sometimes injured by frost. It is stated in the *Bon Jardinier*, that to guard against this, in some parts of France the practice of planting the roots in a dry cellar or shed, secure from frost, has been adopted, and that it presents the double advantage of preventing injury to the plants, and inducing an earlier production of heads. Some plants thus wintered by the Baron de Ponsort are stated to have borne their fruit a month before the usual time.

Artichokes seldom continue in good bearing longer than four or five years; therefore, a fresh plantation should be made every third

or fourth year. As the plants in fresh plantations bear later than those in old ones, some persons make a small plantation every year, with the view of prolonging the season.

If chards are required, when old plantations are to be destroyed, the plants should be cut over a little above the ground as soon as the principal part of the crop has been gathered, and when the leaves are about 2 feet high, they may be tied up and blanched like cardoons.

In Italy, besides the head and chard, another product is obtained from the artichoke; the stem is bent down at right angles, the leaf-stalks collected together, and the whole covered up to blanch. The result is a lump called *gobbo*, or hunchback, which is tender and very good when eaten raw with salt. It is used in autumn and winter, and is advantageously substituted for radishes.

Except in very warm seasons the artichoke never ripens its seed in this country. If, notwithstanding this, an attempt to save seed be made, the heads should be sheltered from rain, either by gradually bending them down so as to throw off the wet, or by some other means. The seed keeps five or six years; but even when it can be saved it is seldom worth the trouble, for no dependence can be placed upon the plants raised from it, many of them producing only small and totally worthless heads, whilst others produce very good ones. It is for this reason that the artichoke is almost invariably propagated by suckers.

ASPARAGUS (*Asparagus officinalis*, L.—Hexandria Monogynia, L.; Liliaceæ, D. C.; Liliaceæ, Lind.) is a hardy perennial, a native of Britain and of the sea-coasts of various countries in Europe and Asia. According to Loudon it is found in abundance on the sandy steppes in the interior of Russia. He also states that it grows near Bristol, in the Isle of Portland, and sparingly in Seaton Links, near Edinburgh. That growing wild in the fens of Lincolnshire is considered by Miller to be undoubtedly the same as the cultivated species. A correspondent of the *Gardeners' Chronicle* states that it is also indigenous to Cornwall, that there is an island near the Lizard Point called Asparagus Island, where the plants grow naturally, and that in heavy gales the sea breaks over the part of the island on which the asparagus grows. It thus appears that it naturally grows in situations near the sea, though it may also be found in salt marshes some distance inland.

Although circumstances of soil, climate, situation, and cultivation may occasion different appearances, there is but one sort of asparagus. In some places it can be grown under the same system to a much larger size than in others, and hence different names have been given to essentially the same variety. Thus, there were sold the Battersea asparagus, the Deptford, Gravesend, Reading, Mortlake, Grayson's Giant, &c.; and on the Continent the names of places noted for the growth of asparagus are similarly applied. Some consider the *Red-topped* or *Dutch* asparagus and the *Green-topped* as two permanently distinct varieties, and that the former is the largest, but the latter the best flavoured. We have found, however, that colour depends greatly on the nature and texture of the soil; and with regard to size, we may mention that in one part of Mr. Grayson's extensive plantations on the south side of the Thames, the so-called Giant variety was produced, and in another part the common sort; but when both were made to change places, the common acquired the dimensions of the Giant, whilst the latter diminished to the ordinary size.

Soil and Situation.—A rich sandy alluvial soil, impregnated with saline matters, is naturally best adapted for the growth of asparagus, and in such soil its cultivation is an easy matter. Soils of a different texture may be made rich enough with manure; but whilst the soil retains too great a degree of stiffness, the results of cultivation will not prove satisfactory, nor will the produce bear comparison with that from soil naturally well adapted for the growth of the plant. In preparing the ground for a plantation of asparagus attention should therefore be directed to the texture of the soil; and if this is too close, as is generally the case, such means should be adopted as will effectually reduce it to a sufficiently light and porous state. The application of large quantities of manure has this tendency, but sand would in many cases be of more permanent benefit, for if the soil be stiff and retentive of moisture, manure reduced to the state of wet humus diminishes its natural adhesiveness but very little. The market gardeners near London are aware of this; for highly as they manure their ground for crops generally, yet they procure sand or sandy mud from certain parts of the Thames for asparagus plantations, where the soil is too heavy.

The situation for asparagus should be open to

the sun, and it is also desirable that it should be sheltered from the quarter from which strong winds prevail, in order that injury from breaking the stems in summer may be prevented.

Propagation.—Asparagus is propagated by seed, which may either be sown on the ground prepared for the plantation, and the plants thinned out to the proper distance, or broadcast, or preferably in drills in beds, where the plants remain till they are one or two years old, when they are finally planted out. The seeds may either be sown when ripe, in October, or in March, if the ground be not then too cold; if so, the sowing should be deferred till April. The soil for the nursery bed should be light, rich, and sandy. In order that there may be room to clean and refresh the ground near the plants, the seeds should be sown thinly in shallow drills, covering it with about half an inch of fine soil.

Preparation of the Ground for the Plantation.—If the ground has been trenched or made good to the depth of 3 feet, as directed for the kitchen garden generally, that depth will suffice for the growth of asparagus. It should, however, be trenched over, and a large quantity of manure introduced, also, near the top, plenty of sandy mud, the scourings of ditches made into a compost, sea-weed where it can be obtained, decayed leaves or leaf-mould, good peat, decayed hot-bed dung, which are all excellent. It may not be practicable to make all the soil so light as some would recommend, but excellent and heavy crops of asparagus are grown where the bottom is a yellow, rather heavy loam, the top, however, being sufficiently light from long working and plentiful manuring. In trenching this for asparagus, of course the heavy subsoil is neither turned up nor mixed with the humus soil, as might be advisable for some crops; on the contrary, the lightest soil is kept upmost, and made still more open by the addition of sandy mud as manure. In this way asparagus weighing 20 lbs. per 100 of the largest heads has been produced. Where the soil is not so deep and the subsoil coarse and rather gravelly, the ground is trenched only one spade deep and a shovelling, the bottom of the trench being then merely dug over. Above this, however, a large quantity of manure is applied, and by this, together with good after management, chiefly consisting in making the soil fine and light for the shoots to push through, excellent crops are produced.

In the asparagus plantations near London the beds were formerly in general 3 feet, and the alleys 2 feet wide. At the present time, however, many beds 5 feet wide with 2-foot alleys are laid down. These widths we consider the best, and would recommend that in making a new plantation some of the beds should be 3 feet and others 5 feet wide. The reason for having some of the beds so much narrower than the others is, that the narrow ones are sooner heated by the sun's rays, and consequently an earlier production is induced.

The distance between the rows may be regulated as follows:—Where the beds are 3 feet wide two rows should be planted along them, each row should be a foot from the edge of the bed, and they will consequently be a foot apart. In beds that are 5 feet wide three rows should be planted, one along the middle and one on each side, a foot from the edge of the bed. The distance from plant to plant in the rows should not be less than a foot; at this distance good sized heads will be produced, but if very large heads are desired, the plants may be 15 or even 18 inches apart in the rows.

Planting.—According to the season planting should be performed late in spring or early in summer. It should not be done whilst the ground is too cold, or, in other words, not before the plants begin to push. If possible, advantage should be taken of mild cloudy weather, when the air is moist; and the planting should only be carried on when the ground is in good working order, not when it is too wet, for in that case it would become puddled in the process. The 3-foot beds should be traced out to run east and west, or so as to present the side of the bed to the direct action of the sun's rays when they are most powerful. In this way they have greater effect than when the end of the bed is presented to their influence; and the consequence is that the asparagus in beds so formed pushes earlier in the season than it does in beds running north and south. For all, except the earliest beds, the direction is immaterial, and they may be run east and west, or north and south, as may be most convenient. In proceeding to plant, the beds and alleys should be marked off at the required distance. A stout peg or small stake should be driven in at each corner of the beds, and from these the distances for the rows should be measured. There are various ways of planting; some stretch a line and cut out a trench, as if for laying box, only deep enough

to allow the roots to be laid out without doubling, and they are spread out like a fan against the cut, the crown of the plant being kept 2 inches below the surface. Some dig out a trench, and at the proper distances form little hillocks of fine soil, over which the roots are spread. Others make a ridge, on the top of which they set the plants, spreading their roots on each side of the ridge; and, again, some take off a portion of the soil of the bed, and after the surface has been raked smooth, the roots of the plants are spread out on the level. The position given to the roots by this method is not natural, therefore we cannot recommend it; but any of the other modes may be adopted; in extensive plantations the first is generally practised, as it is the most expeditious, and answers very well; but whatever method be preferred, the crowns of the plants should all be on the same level, otherwise those that are too high would be liable to be injured by the knife in cutting. Good plants one-year old are generally preferred, but some employ two-year old plants. They should be carefully taken up with a fork, and the roots preserved as entire as possible. They should not by any means be allowed to get dry, to prevent which they may be laid in flat baskets as they are taken up, and immediately covered over with beaten wet moss, or damp grass; and in planting, as soon as the roots are put in proper position, they should instantly be covered with the soil. After the plantation is completed the ground will require to be kept moist; and if, notwithstanding due care in this respect, some failures should take place, they may be made good by reserve plants, which will succeed if planted even as late as the end of June, especially if shaded on transplanting. In proof of this we may adduce the following instance of the success of late planting. Mr. Fleming of Trentham states (*Gardeners' Chronicle*, 1844, p. 276), that after having made a new plantation with the greatest possible care, about the middle of March, he found that many of the plants had perished after planting. It was June before he could take any decided step to remedy the evil; he then procured several thousands of two-year old plants, took up those that had not died, and, beginning entirely anew, had the ground dug over again, and replanted with the fresh plants, and although they had tops 8 or 10 inches high, scarcely one failed. "Many of the tops, indeed, withered and turned brown, but were

in all cases succeeded by a fresh growth. The plants were taken up carefully, the roots were immediately covered with moss, and were kept moist till the moment of planting. In the course of the season the beds received several copious waterings with salt water. In the spring of 1843, before the shoots made their appearance, the beds were sprinkled with salt sufficiently thick to make them appear white, and the waterings with salt water were repeated several times through the summer season, and by September the shoots were 5 feet high. Since the 15th of this month (April, 1844) we have gathered daily a good supply of fine asparagus from these beds. I should mention, that when the beds were planted the second time, the plants which were taken out (the remnant of the first planting) were put into two beds by themselves, where they grew very well, but not so strong as the others. It may appear that asparagus planted in March, and having the whole season to grow in, must have a better chance of doing well than that which is transplanted in the middle of its growth; but I conceive that whatever advantages may arise from early planting are counterbalanced by the ground being cold and wet, and the roots of the plants being so tender that many of them perish before the vegetative principle is excited; while at a later period the case is different, as the juices of the plant are in motion at the time, and the soil being in a warm and genial state, is prepared to encourage immediate growth. I planted six more beds last year, also in the beginning of June, which, under the same treatment as the others, seem likely to do as well."

Instead of rearing the plants, and then transplanting them when one or two years old, some prefer sowing the seed where the plants are to remain. When this method is adopted, shallow drills, at the distances marked out for the rows, should be formed, and in these the seeds may be sown thinly, and covered with about half an inch of fine soil; or the distances at which the plants are to stand in the rows may be marked out, and three seeds inserted, about half an inch apart, at the place which each plant is to occupy; the seeds should then be covered with rich light soil to the depth of half an inch, or rather more. When the seedlings are 2 inches high, they should be thinned out to the requisite number of plants in the rows; and in thinning, the weakest should be removed.

After-management.—During the summer and autumn the ground should be kept free of weeds and stirred, but without disturbing the roots; and when the stalks are completely withered in autumn, they should be cut down and burned. The surface of the beds should be lightly stirred, and about 3 inches thick of manure and soil spread over the beds. In the following February, if the weather permit, the beds should be forked over carefully, so as not to injure the crowns; and the soil should be left rough, in order that the rain may not run off by the surface but soak into the beds. The alleys should also be forked over. Before the asparagus begins to push, the soil should be again stirred, but this time it should be broken fine with the fork, and raked. The beds should then be lined off afresh, and some soil from the alleys laid on them, and after exposure to the weather for some time, it should also be broken fine, the beds made level to their full width, and the alleys straight. In autumn, when the stalks are cut down, the surface of the beds should be hoed off into the alleys; and both beds and alleys should be forked over, lowering a little the surface of the former at the same time, and leaving the whole rough for the winter. In spring, the forking, rendering the soil fine, and making up the beds before the buds begin to push, performed the previous spring, should be repeated. The thickness of soil to be laid on the beds from the alleys depends on whether blanched or green asparagus is preferred. In the third year the beds will admit of some asparagus being cut, but this should only be done sparingly, in order that the growth of the plants may not be checked. For, as the increase of roots depends on the quantity of foliage, there must be shoots enough left to bear it. In the fourth year, however, the beds will be in full bearing.

In cutting asparagus, a little of the soil is taken from beside the shoot with the asparagus knife, which is then pushed down, but so as not to endanger the crown, or other shoots that may be pushing up, then turning the edge of the knife towards the shoot, the latter is cut, or rather sawed off. It is the practice near London to cut off all the shoots as they appear, up to the period when it is thought proper to leave off cutting altogether; the period for doing this depends on the climate, season, nature of the soil, and strength of the plants. Where the climate is good, or when the season is an early one, cutting must commence early; and,

of course, in that case, it ought not to be continued late, otherwise the plants will be weakened. When green pease can be had, asparagus is less required; so that, in the southern parts of the kingdom, the cutting may cease towards the middle of June, and in the northern parts, by the end of that month. If the plants are weak, they ought to be allowed to grow up as early as possible to make foliage, and consequently fresh roots, and thus to acquire more vigour for the ensuing year. It is also advisable to leave off, at an early period, the cutting some of the best of the beds formed for early produce, in order that the shoots may be well matured early in autumn; and, consequently, that the buds may be prepared to push vigorously early in spring.

By essentially the same mode of cultivation as we have above pointed out, excellent asparagus is produced. As it is a more simple and less expensive method than many others that have been proposed, we give it in the first place. Those who may incline to adopt it should bear in mind, that plenty of manure is necessary; that if the soil be not naturally so free and open as might be desirable, yet the top must be made light, or at least rendered sufficiently open for the shoots to push readily through it; and that the surface of the beds should be forked down and left rough, so that the soil may be acted upon by the weather, and in order that rain may soak down and thoroughly moisten the soil where the lower roots are situated.

Besides the above, there are various other modes of cultivation, which we shall lay before our readers; but as the application of artificial manures forms the most striking peculiarity of some of these systems, it will be necessary, before proceeding further, to give some account of the results produced by the application of this class of manures to asparagus.

Artificial Manures.—The effect of these on the growth of asparagus is exceedingly variable, and is greatly influenced by the greater or less dryness of the season. This was proved by some experiments made in the garden of the Horticultural Society, and of which an account is given in the Society's *Journal*, vol. i. p. 264.

The substances were applied to separate beds, the surface of each being equal to 100 square feet, or about 11 square yards, and the resulting growth was estimated by the weight of haulm produced, as compared with that from

a bed to which no manure was given. The following were the manures applied, their respective quantities, and the modes of application:—

Potter's Guano, 2 lbs. in 16 gallons of water, applied once a-fortnight, commencing in the second week in July. Total quantity applied, 18 lbs.

Guano and Salt, guano 10 oz., salt 12 oz., in 16 gallons of water, applied once a-week, for 17 weeks. Total—guano, 10 lbs. 10 oz.; salt, 12 lbs. 12 oz.

Sulphate of Magnesia, applied at once, spread over the bed in the middle of June. Total, 20 lbs.

Sulphate of Magnesia, applied in 16 gallons of water, once a-fortnight, commencing in the second week of July. Total, 18 lbs.

Guano, applied like the preceding. Total, 18 lbs.

Salt, applied at once in the middle of June, like the sulphate of magnesia. Total, 20 lbs.

Nitrate of Soda, applied at once, like the preceding. Total, 20 lbs.

Superphosphate of Lime, applied once a-fortnight, in 16 gallons of water. Total, 18 lbs.

The following table exhibits the increase or decrease per cent. in the weight of haulm produced by the beds experimented on in the years 1843 and 1844; the comparison being made with the bed that had no manure:—

	1843.		1844.	
	Increase.	Decrease.	Increase.	Decrease.
No manure, .....	...	...	...	...
Potter's guano, ..	55	...	3	...
Guano and salt, ..	51	...	...	...
Sulphate of magnesia, applied at once,	44	...	43	...
Ditto, once a-fortnight,				
Guano,	42	...	6	...
Salt,	22	...	...	...
Nitrate of soda, ..	18	...	84	...
Superphosphate of lime, .....	...	37	37	...
	276	37	173	37

It will be seen from the above, that the increase in produce of the manured beds, over that to which nothing was applied, was, on the whole, much less in 1844 than it was in 1843, the latter was a wet season, whilst the former was very dry up to the end of the growing season—a circumstance which will doubtless account for the difference between the results obtained in the two years. It is remarked in the *Society's Journal*, that, "in 1844, most

probably owing to the dry state of the weather, the results from Potter's guano fell from an increase of 55 per cent. to 3. Guano and salt, in a like manner, from 51 to 0. Sulphate of magnesia, applied at once, gave the steadiest results, being an increase of 43 or 44 per cent. in both years; but this substance, applied at intervals in 1844, and in that year with the addition of 18 lbs. of muriate of lime, fell back 81 per cent. Superphosphate of lime, on the contrary, raised the produce 74 per cent., or from 37 less than that from the bed which had no manure, in 1843, to 37 above it in 1844.

Taking the average of the two years—

Nitrate of soda gave an increase of.....	51 per cent.
Sulphate of magnesia, applied at once, 43½	"
Potter's guano,	29 "
Guano and salt,	25 "
Guano,	24 "
Salt,	11 "

From the above it appears that common salt was inferior as a manure to all the other substances employed. Of these, nitrate of soda is at the head of the list, whilst salt ranks the lowest, the difference between the two being 40 per cent. It follows, according to the above experiments, that nitrate of soda should be employed in preference to salt. The latter, however, can always be readily obtained, and being of all artificial manures the one most frequently employed for asparagus, it is necessary to say a few words respecting its application. It may be applied at the rate of 2 lbs. per square yard. This we consider a good dressing. Less than this will do good, and much more will not do any harm. Mr. Coulam states (*Gardeners' Chronicle*, 1844, p. 444), that he applied salt at the rate of upwards of 12 lbs. per square yard, and with decidedly beneficial effects. In our opinion, the best time for salting asparagus beds is in spring, before active vegetation takes place. It should be scattered over the bed, and allowed to wash gradually into the soil with rain, or by occasional watering through the rose of a watering pot. Thus applied, it has the effect of ameliorating and rendering the soil more friable, so that the shoots can push through with facility. We have seen it more advantageously applied in this way, than in repeated waterings with solutions. If weeds are troublesome, solutions, strong enough to kill them, may also be occasionally employed in summer. For this purpose, independent of its manuring properties, salt is very useful; and it is also particularly

so for the destruction of the wireworm, and other insects which injure the roots of asparagus, and ultimately kill the plant. Salt should not be applied to plants recently removed, for all such, however carefully transplanted, must have wounded roots; and it is, doubtless, to its application under these circumstances, that the injurious results which have, in some cases, followed its use, are to be ascribed. Again, salt should never be applied when the roots are in a dormant state, as late in autumn and in winter, for at that period the plants cannot avail themselves of the nourishment it affords; besides which we know that in many cases the roots have been destroyed by its application at that period of the year. This result may be caused by the formation of a frigorific mixture* of the salt with snow or ice, by the moisture which the salt attracts rotting the roots, or by both these causes combined.

Different Modes of Cultivation.—Mr. Errington says:—"With regard to the preparation of ground, I will commence with pease, which always precede celery in my rotation. I appropriate a considerable plot for these, or in other words, I keep them together as much as possible for the sake of system; and having an even number of rows, I make it a rule to sow two at a time, at the distance of from 4 to 5 feet, and these when picked, and the haulm cleared away, furnish space for a bed of celery of about the same width. The pease being removed, the ground is marked out for the celery bed, after what is termed the Scotch method. The bed is now excavated to the depth of a foot, and the soil thrown right and left and made compact; and now 6 or 8 inches of half-decayed leaves and dung, chiefly the former, and which had been used as linings to pits or frames, is trenched in, at least a foot deep in the excavation. The surface is now covered once more with 3 inches of the best rotten manure, which, when spread, is forked in and duly mixed. The bed is now planted, and when taken up for use, the operation, with a little care, levels and leaves the bed right for planting the asparagus when the period arrives."

* On the mixture of equal parts of salt and snow or pounded ice, these substances become liquid, and intense cold is produced, a thermometer placed in the mixture sinking to zero, or 32° below the freezing point. In fact, Fahrenheit determined the commencement of his scale by this very means. Placed in a mixture of one part by weight of sea-salt and two of snow, the thermometer sinks from any temperature to 5° below zero.

Mr. Errington invariably plants in May, when the asparagus is what the market gardeners term "in feather," that is, when the plants are about 6 inches high; and he states, that from many years' experience, he has found this the best time.

"In planting, the beds are set out for two rows each; the rows 2 feet apart, with an alley of 4 feet between them. The line being stretched precisely where the asparagus is to be, a slanting cut is made sloping from the line, about 9 inches deep, and the soil thrown out, as in forming an edge for box; the same cut is made on the opposite side of the line, leaving a sharp and angular ridge, across which the plants are set astride; the operator taking half of the roots in the one hand, and half in the other, divides them across the ridge, at the distance of 10 inches between plant and plant.

"Previous to planting, however, some fine highly decomposed old vegetable matter is placed up the line, in contact with the roots, and pressed firm; the roots are slightly tipped, and dipped in a puddle of thick dung-water. My plants are usually two years old, for it is a waste of ground to plant earlier, unless in cases of emergency. I need scarcely add, that the young plant must be watered every morning for a week, unless rainy.

"The only treatment necessary the first year, at least through the growing season, is to keep them perfectly free from weeds. If any crop is planted between them, it should be a row of coleworts, which would make their growth chiefly after the asparagus had done its best.

"In November, the ground is dressed with good rotten manure, and in spring the alleys are thrown over the manure, just deep enough to cover it. No cropping can now be carried on between the rows, although a good crop of cauliflowers may be grown in the alleys. The next point is the mode of dressing pursued in the autumn of the second year.

"I hold it of much more importance to feed the asparagus at the extremities of the roots in the alleys, than over the crown; good cultivators of it in brick-pits, do not allow the alleys, after forcing, to remain empty all the summer; they are filled with good rotten manures, and any one who has witnessed the emptying of these alleys in autumn, preparatory to forcing, must have been struck with the abundance of strong white roots, of which such alleys are full, and which are annually

(it may be) cut off. Such roots can scarcely be produced from the crown; and it occurred to me, some years ago, that the alley, above all, should be well attended to with manure. I, therefore, in November of each year, as soon as the ground is cleared of dead stalks and weeds, cause all the loosest of the soil to be drawn off the beds with a rake; the bed is then well dressed with very rotten manure, and left for the winter. In February, the alleys are dressed, about from 6 to 9 inches thick, with half-rotten manure and leaves, from partially decayed linings, which is trenched down very deep, and the bed is then soiled over the manure, to the depth of 4 inches, with fresh soil from the alleys. This completes the whole course of my mode of culture.

"My mode of cutting is similar to the market gardeners', excepting that after cutting about twice in the spring, I leave one stout shoot to each stool, with the intention of promoting the fibrous action of the root. As for the rest, I cut all that are of any size until about the end of May, when I cease cutting a bed or beds of my prime, which I now suffer to grow for the earliest cut in the following spring, continuing to cut from the rest until about the end of June."—(*Gardeners' Chronicle*, 1844, p. 668.)

Mr. Niven (*Treatise on an Improved and Cheap Method of Cultivating Asparagus*) adopts as a principle the enriching of the surface soil and the encouragement of surface roots, in opposition to the usual practice of deep trenching and deep manuring. He recommends the surface of the soil to be enriched with half-rotten leaves, or rotten hotbed dung, to the depth of 3 inches, adding, if it can be obtained, a stratum of sea-weed. Before planting, the ground is laid up in small ridges, and the roots are spread as it were astride these ridges at 6 inches apart. The roots and crowns are then immediately covered with sand about an inch thick, pressing it a little, so as to secure the roots from the action of the air. When the planting is finished so far, a second covering of about 4 inches of rich compost of dung and rotten leaves is put over the ridges. A small portion of the original surface between the rows is then thrown up with the spade right and left, dressing neatly between every two lines, and the process of planting is finished. When the shoots come up they are thinned by cutting away the weakest, so that by the

end of the first season, not more than two, or at most three shoots are left to grow to maturity on each plant. In autumn, when the tops have become yellow, about 4 inches of thick sea-sand is laid over the line of plants and rotten dung; leaves and sea-sand are slightly stirred into the soil between the ridges.

Mr. Beaton says:—"By far the best way of growing asparagus is in single rows, 3 feet apart, and 9 inches plant from plant; but if the ground is not deeper than 2 feet or 30 inches, or if room is scarce, the rows need not be more than 30 inches asunder. I have grown asparagus this way for the last fifteen years, and give them no dung in winter, merely clearing off the stalks and weeds in October, and pointing over the surface about 2 inches deep with a fork, and leaving it as rough as possible. Early in March, when the surface is quite dry, it is raked down, and about 2 inches of soil drawn over the crowns from each side of the rows, which gives the ground something of the appearance of a plot of pease earthed up for the first time; when the gathering is nearly over, the ground is stirred again to loosen the tramping made in gathering the crop. The hollow between the little ridges is then filled up with a powerful compost, consisting of equal portions of sandy soil, leaf-mould, and pigeons' dung; the whole is then drenched with liquid manure from the stables, cow-houses, or laundry, and the foreman of the kitchen garden gets *carte blanche* to water the asparagus any day through the growing season when he can best spare his men, or at all events, every fortnight, and always with liquid manure if possible; as to the quantity of water, the only instruction he gets is that he cannot drown them."—(*Gardeners' Chronicle*, 1843, p. 387.)

Mr. Buchan, who has long occupied a first-rate position among judicious gardeners, gives the following account of a mode of cultivation which well deserves notice. He says:—"In preparing and planting the beds I do not deviate from the usual practice, nor indeed until the plants have become sufficiently strong to produce asparagus fit for cutting; I then, in the spring of the year, put a quantity of sand in ridges between the beds, and as the asparagus begins to make its appearance above the ground, I cover the beds with sand about 2 inches deep, which operation I again repeat as the asparagus reappears, until the sand be-

comes 7 or 8 inches in depth. When asparagus again makes its appearance I commence cutting it for use, making the sand level again after each cutting. In the autumn the sand is raked into ridges in the alleys, which affords shelter to the beds during the winter and early spring months; a covering of rotten dung is then put on, which remains till the ensuing spring, when the roughest portions are raked off, and the same process pursued as before described. The advantages attending this method of cultivation are, that the blanched part of the asparagus is more tender, the colour more delicate, and the flavour improved; besides which, the covering of sand prevents an inexperienced operator from injuring the crowns of the plants in the process of cutting; nor are they so liable to rot in the winter as when the beds are covered to a great depth with dung and soil.”—(*Gardeners' Chronicle*, 1841, p. 86.)

Irrigation was successfully tried by Mr. Foster of Winchester, who says:—“I have three beds 60 yards long, four rows in each bed. These were laid down three years ago with seed. From the 1st of October to the middle of February, the beds were this last season, except about 4 rods, completely flooded to the depth of from 6 to 12 inches. When the water went off in the end of February, I ordered the beds to be forked over, with the intention of drying the ground, and getting the roots into health; but the shoots were appearing on every part; and on the 4th of March I cut 400 of good quality, and continued to cut 100 per day ever since. Even the last frosts did not stop it; but, at such times I took the precaution of covering such shoots as rose during the day by small flower-pots in the evening.”—(*Gardener's Magazine*, vol. iv. p. 235). It appears from the above that the flooding had the effect of making the asparagus push earlier than usual.

According to Captain Churchill, the following mode of cultivating asparagus is pursued at San Sebastian in the north of Spain:—“At the mouth of the Urumea is a narrow slip of land, about 3 feet above high-water mark, consisting of alluvial soil, and the wearing away of sandstone hills, at whose foot it is placed. This is the asparagus ground of San Sebastian. Beds are formed 5 feet wide, without any previous preparation, except digging and raking. In March the seed is sown in two drills, about 2 inches deep, and 18 inches from the alleys,

thus leaving a space of 2 feet between the drills. The rows run invariably east and west, doubtless in order that the plants may shade the ground during the heats of summer. When the seedlings are about 6 inches high, they are thinned to something more than a foot apart. Water is conducted once a-day among the alleys and over the beds, so as to give these seedlings an abundant and constant supply of fluid during the season of their growth. This is the cultivation during the first year.

“The second year, in the month of March, the beds are covered with 3 or 4 inches of fresh night-soil from the reservoirs of the town; it remains on them during the summer, and is lightly dug in during the succeeding autumn; the operation of irrigation being continued as during the first season. This excessive stimulus, and the abundant room the plants have to grow in, must necessarily make them extremely vigorous, and prepare them for the production of gigantic sprouts.

“In the third spring the asparagus is fit to cut. Doubtless all its energies are developed by the digging in of the manure in the autumn of the second year; and when it does begin to sprout, it finds its roots in contact with a soil of inexhaustible fertility. Previously, however, to the cutting, each bed is covered in the course of March very lightly with dead leaves, to the depth of about 8 inches; and the cutting does not commence till the plants peep through this covering, when it is carefully removed from the stems, in order that the finest only may be cut, which are rendered white by their leafy covering, and succulent by the excessive richness of the soil.

“In the autumn of the third year, after the first cutting, the leaves are removed, and the beds are again dressed with fresh night-soil as before; and these operations are repeated year after year. In addition to this, the beds are half under salt water annually at spring tides.”—(*Gardeners' Chronicle*, 1842, p. 187.)

Captain Churchill states that the asparagus grown in this way measures from 3 to 6 or more inches in circumference.

M. Behrens of Travemünde, near Lübeck, gives the following account of the mode in which asparagus is cultivated in his neighbourhood. He says:—“It is never planted otherwise than in a deep, light, and sandy soil, which has been trenched to a depth of 3 feet, well drained and well manured. A thick

layer of horse-dung is put on the bottom of the trench, and mixed with the soil. Strong loamy or clayey soil is decidedly disadvantageous to the growth of this vegetable. It will not thrive in it, does not become tender, and will very often become brown spotted, which the common people here call iron mould (*cipumala*), especially if drainage has been neglected.

"We take plants of two or three years' growth, according to their vigour, and usually plant them in furrows, which are made at 2 feet distance, and from $1\frac{1}{4}$ to $1\frac{1}{2}$ foot deep. The distance between the plants is likewise 2 feet. In these furrows the plants are permitted to grow uncovered from the month of March or April, the usual and best time for planting, till the beginning or middle of November, at all events till severe frost is coming on. The soil, which has been taken out of the furrows and heaped up at the sides, is then put in, and the beds are completely levelled. The plants have had time during summer to establish themselves sufficiently.

"Next spring the young shoots will make their appearance above ground; and if everything has been duly attended to—if strong and healthy plants have been selected, and if, besides, water has been given during a dry season—not a single one ought to fail. Some people begin to cut the strongest shoots in the third year, but a better result will be obtained by leaving them undisturbed till the fourth summer, only giving them every spring, in February or March, a good dressing of cow-dung. Manure is the most essential requisite for growing fine and tender asparagus. The shoots are cut at sunrise and late in the evening, at a length of not more than 9 inches, cutting them with a long knife under ground as soon as the top of the shoot is lifting the soil. Asparagus will always have the finest taste if eaten immediately after having been gathered, but ought never to be kept longer than one day, and should be covered meanwhile with light earth, sand, or some other material of this description. It is a very bad practice, lately in use with our market gardeners, to immerse the asparagus immediately after cutting in a tub of water, leaving it in the water till they bring it to market. By this practice the finer flavour is altogether lost, and the cooks should be warned against doing the same.

"Wherever manure is not a very expensive

article, the culture of asparagus pays well, since the lightest and the most sandy land, where nothing else can be grown with advantage, can be easily adapted to its culture, and will yield a rent for a long series of years. Living myself some hundred steps from the Baltic, and having read different accounts of the famous asparagus culture at the sea-coast near San Sebastian, in Spain, I last year made the experiment of growing it in pure sea-sand, containing no humus or vegetable matter whatever. It only received a moderate supply of manure, and has even not been watered during the last hot summer; nevertheless, it is growing this year so well, that I might have cut a tolerable quantity of shoots, as big as a lady's finger, had I been foolish enough to have done so."—(*Gardeners' Chronicle*, 1847, p. 404.)

According to the Vienna mode, the beds, if $3\frac{1}{2}$ feet wide, are planted with two rows of asparagus, and with three rows if the beds are 5 feet wide. Three-foot spaces are allowed between the beds; the latter are made from 3 to $3\frac{1}{2}$ feet deep, the soil being well screened through a sieve. In the bottom is placed a foot of fir leaves and earth taken from under the trees, or else wood shavings, rotten wood, or other substances that will act as drainage. Then 6 inches of clean earth passed through a sieve, above this 6 inches of manure, then 6 inches of good earth, another 6 inches of manure, and finally 6 inches of fine rich soil. The asparagus is planted in April on hillocks 3 inches high and 12 inches in circumference, and on these the roots are spread out all round and covered with a little hotbed soil; the whole bed is then covered to a good inch over the tops of the roots. After planting, the beds are gently watered. When the plants are of sufficient age for cutting, a hollow earthenware covering, pierced with a small hole at top, is placed over the shoots as soon as these are about 6 inches high.

Duration of the Plantation.—Asparagus beds in favourable soil will continue to bear well for many years if properly managed, especially as regards cutting; but if too severely cut they will soon become unproductive, however well they may have been originally formed, or however good their treatment in other respects. By continually cutting off all the shoots throughout the season, as they appeared, the plants would be completely destroyed, just as the most obstinate weeds would

ultimately be if so treated. If a strong asparagus root were allowed to mature all the shoots it produced, these of course would return organized matter for the production of a proportionate quantity of fresh roots. But if all the shoots are cut off as they appear, except one, perhaps, late in the season, sap cannot be elaborated for the proper maintenance of the whole of the roots, and, consequently, a portion of those least in connection with the shoot which is left will perish. Pursue the same severe process of cutting on this plant the following season, and after that expect to find a blank in the part of the bed which the plant once occupied, and which it would have continued to have done if it had been under a more merciful treatment. When blanks begin to appear in beds, the latter should, in future, be more sparingly dealt with. There is only one case in which severe cutting is excusable, and that is, when a piece of asparagus is about to be thrown up, then market gardeners and others cut as long as the produce pays for the trouble of cutting.

From the above considerations, and from actual observations, we have no hesitation in stating that the duration of asparagus beds mainly depends on the more or less judicious manner in which cutting is conducted. If carefully attended to in this respect, the beds may continue in good bearing for fifteen or twenty years, and even longer; but it is better to calculate on ten or twelve years' duration. It should, however, be recollected, that to have fresh beds in bearing condition to supply the place of those past good yielding, four or five years must elapse from the time of sowing, and therefore it will be necessary to be prepared with seed for that purpose.

To save Seed.—Some of the finest shoots which push in the early part of the season, and on the south sides of the beds, should be allowed to run up for seed. As the stems grow up, some of the most promising may be tied to stakes to prevent breakage by the wind; but in doing this care should be taken not to crowd the branches, in order that the foliage may be as freely and equally exposed to the light as possible. With the growth of plants so reserved, that of others adjoining should not be allowed to interfere. When at maturity the largest berries, of the finest red, should be selected. After lying a week or two they may either be squeezed between the hands, and the seeds washed from the pulp, or

the berries may be dried, in which case the seeds will keep the longest.

Insects, &c.—Considerable damage is sometimes done to asparagus plantations by the larvæ of the asparagus beetle (*Crioceris asparagi*), which feed upon the leaves, perforate the buds, and even gnaw the rind of the stems. The larvæ, beetles, and eggs are found from June to the end of September; picking off the larvæ and beetles, or shaking them into a net, appear to be the only means of freeing the plants from this insect.

BALM (*Melissa officinalis*, L.—*Didynamia Gymnospermia*, L.; *Labiata*, D.C.; *Lamiaceæ*, Lind.)—is a hardy perennial, a native of the south of Europe.

It is chiefly used for making balm tea and balm wine, though its young shoots are sometimes employed in salads instead of parsley.

It prefers a light warm soil, and is propagated by parting the roots in October, or in February and March, three or four buds being preserved on each piece; or by slips in spring. The divisions or slips should be planted about a foot apart. The subsequent culture is confined to keeping the ground free of weeds, and stirring it occasionally, and the stems should be cut down when the frosts set in; by these means the plants will remain vigorous for many years. When coming into flower some should be gathered and dried for winter use.

BASIL (*Ocimum*, L.—*Didynamia Gymnospermia*, L.; *Labiata*, D.C.; *Lamiaceæ*, Lind.)—The aromatic leaves and tops of this plant are used in soups, stews, sauces, and some other dishes, occasionally also in salad; but the strong flavour of cloves which they possess is disagreeable to many persons. Sometimes the leaves and tops, cut when coming into flower, are dried and reduced to a powder for winter use.

Two species are cultivated:—

1. COMMON SWEET BASIL (*O. Basilicum*, L.)
2. BUSH BASIL (*O. minimum*, L.)

These are both annuals, and natives of the East Indies; the second sort is smaller and rather more hardy than the first. They are both raised from seed.

Basil should be sown on a gentle hotbed in the beginning of March, and when the young plants come up, they should be thinned out where too close, otherwise they will draw up weak. The thinnings may be planted on another hotbed, or in pots or boxes, in a pit or vinery. Plenty of air and frequent waterings

should be given in mild weather. Having been hardened off, the young plants should be lifted with balls in May, or as soon as all danger of frost is over, and planted out in a light rich warm border. The larger sort may be planted 6 or 8 inches from plant to plant, in rows a foot apart, and the smaller one 5 or 6 inches apart, in rows 9 inches asunder. The plants should be shaded, and occasionally watered till they take root afresh; afterwards they only require to be watered in dry weather, and to be kept free of weeds.

The seed being seldom ripened in the open air in this country, is imported from the continent.

BEAN, The, (*Faba vulgaris*, Mœnch.; *Vicia Faba*, L.—*Diadelpchia Decandria*, L.; *Leguminosæ*, D.C.; *Fabaceæ*, Lind.) is a hardy annual, a native of the East, of what part is uncertain, but Persia is usually considered to be its native country.

The varieties cultivated in gardens are:—

1. **EARLY MAZAGAN**—syn. Mazagan, Stidolph's New Early, Early Bromley, Early Malta, Early Aldridge, Fève de Mazagan.—Stems rather slender, 2 to 4 feet high; pods containing three, seldom more than four beans, which are small, oblong, and thick. It is esteemed one of the best sorts for early crops, and should be sown in October, November, January, and February.

2. **MARSHALL'S EARLY DWARF PROLIFIC**—syn. Marshall's Prolific.—Stems $1\frac{1}{2}$ to 2 feet high, branching close to the stem; very prolific—producing in clusters, pods resembling those of the Mazagan, but containing somewhat larger beans, and nearly a fortnight earlier.

3. **LONG POD**—syn. Common Long Pod, Early Long Pod, Large Long Pod, Hang-down Long Pod, Sword Long Pod, Windsor Long Pod, Turkey Long Pod, Moon, Wrench's Early Moon, Lisbon, Early Lisbon, Sandwich, Fève à longues Cosses.—Stems 3 to $4\frac{1}{2}$ feet high; pods long, not very broad, generally containing four beans of good quality. Being very productive, this sort is generally one of those employed for the principal summer crop, especially in cottage gardens.

4. **GREEN LONG POD**—syn. Green Nonpareil, Green Genoa, Fève verte, Fève toujours verte.—Stems 3 to $4\frac{1}{2}$ feet high; pods long, a little flattened, generally containing four rather small oblong beans, which are green both when young and when ripe. They are much valued by some for their green colour when served up at table,

but they require to be gathered when very young, otherwise they lose that fine colour in cooking. A good bearer, and in point of earliness succeeds the Long Pod.

5. **DUTCH LONG POD**.—Stems 3 to $4\frac{1}{2}$ feet high; pods long and broad, containing from four to six large, broad, white beans of good quality. An abundant bearer later than the Long Pod.

6. **WINDSOR**—syn. Broad Windsor, Kentish Windsor, Taylor's Windsor, Taylor's Large Windsor, Taylor's Improved New Windsor, Wrench's Improved Windsor, Mumford, Small Spanish, Fève de Windsor.—Stems 3 to 4 feet high; pods short, but very broad, seldom containing more than two beans, which are very large, roundish, flattened. Esteemed the best for a summer crop, remaining longer fit for use than any other, with the exception of the two following:—

7. **GREEN WINDSOR**—syn. Toker, Fève de Windsor verte.—Similar to the Windsor, excepting that the beans retain a green colour after being ripe.

8. **GREEN CHINA**—syn. Fève verte de la Chine.—Stems about $2\frac{1}{2}$ feet high; pods long, roundish, containing three or four beans, which remain green even when dry; an abundant bearer, and in some cases may be found useful on account of its coming in late.

9. **DWARF CRIMSON-SEEDED**—syn. Fève très naine rouge, naine rouge.—The earliest and dwarfest of all the sorts of beans; stems scarcely attaining a foot in height, branching close to the ground, and bearing profusely; pods about 3 inches in length, generally well filled; the beans are crimson, and nearly the size of those of the Long Pod. It may be grown in rows from 12 to 15 inches apart, and might be very conveniently introduced into systems of intermediate cropping, as it would occasion but little shade.

10. **DWARF FAN**—syn. Fan or Bog, Dwarf Cluster or Bog, Fève naine hâtive à châssis.—Stems $1\frac{1}{2}$ to 2 feet high; pods small, nearly round, containing seldom more than three small oblong beans.

11. **WHITE BLOSSOMED**, or White Blossomed Long Pod.—Stems 3 to 4 feet high; pods long, nearly round, usually containing four beans, which are somewhat oblong, of a dingy white colour when dry; only a moderate bearer, but is sometimes sown in May and June for the later crops.

12. **RED BLOSSOMED**—syn. Scarlet Blossomed,

Purple Blossomed, Early Asper, Fève à Fleurs pourpres.—Stems 3 to 4 feet high; pods short; beans generally three in a pod, of a dingy colour when ripe; more ornamental in blossom than useful for fruit.

13. DARK RED, or RED WINDSOR.—Allied to the Windsor, but differs in the beans being of a light red colour when young, dark red when ripe; its colour when cooked is objectionable. The Fève violette has similar characteristics.

The best sorts for early crops are Marshall's Early Dwarf Prolific, Early Mazagan, and Green Long Pod; and for the later crops, Dutch Long Pod, Windsor, and Green Windsor.

Soil.—The bean has a long tapering root, extending downwards in a perpendicular direction to a considerable depth. Shallow soils are therefore not well adapted for it. That which is most suitable for the main crop is a deep, well-drained, rather strong loam; but for the first crops a light warm soil should be chosen. It may be inferred that the soil which contains the substances which are peculiarly abundant in the composition of the plant will be most suitable for its growth. These are exhibited in the following table, which is the mean of six analyses by Messrs. Way and Ogden:—

	Beans.	Bean-straw.
Silica,.....	0.88	3.86
Phosphoric acid,	31.87	7.35
Sulphuric acid,.....	4.50	3.21
Carbonic acid,	1.94	22.73
Lime,.....	8.65	21.29
Magnesia,	6.55	4.88
Peroxide of iron,.....	0.36	0.90
Potash,.....	42.13	21.26
Soda,.....	0.90	4.56
Chloride of sodium,.....	1.90	9.05
Chloride of potassium,.....	0.34	0.90
	100.02	99.99

From the above it appears that lime, potash, and magnesia occur in large quantities, and that a large proportion of phosphoric acid is also present, together with a considerable quantity of sulphuric acid. Aluminous soils usually contain large quantities of potash, soda, phosphoric and sulphuric acids, and, accordingly, it is found that excellent crops of beans are obtained from such soils, provided they are at the same time rich enough in organic matter. It has been found by analysis that the bean

contains a large amount of nitrogen; hence, in addition to the inorganic substances above-mentioned, a soil rich in decaying animal or vegetable matter is required.

Manure.—As beans in garden culture are gathered young, it is obvious that any manure which it may be thought necessary to apply ought to be given so as to be available to the plants at an early stage of their growth. Manure may, however, be applied at the proper time, and it may cause a luxuriant growth; still it may not be the best kind that could possibly be selected, for a luxuriant growth is frequently in some respects imperfect or unsound, and when this is the case the produce must be more or less vitiated. Produce of the highest excellence, whether fruit or vegetable, or farinaceous substance, can only be obtained from plants so circumstanced as to be enabled to make a healthy growth. Manure will generally promote a luxuriant growth in plants in most soils, but if in these soils elements essential to the growth of the plant should be deficient, and at the same time do not exist in the manure, then the growth of the plant must be so far defective; for, though a plant can appropriate certain substances necessary for its growth when they are present in the soil, yet it cannot create them, however necessary they may be for its perfect organization. The aim should be to supply, as far as possible, elements that are deficient; and the first step towards this is to ascertain what they are. Old garden soil, long cultivated and manured with organic manures, is, in many instances, reduced to a mass chiefly consisting of inert humus, the mineral constituents of plants being deficient to a great extent. Lime, marl, gypsum, superphosphate of lime, bone dust, wood ashes, and burned clay, will prove highly beneficial to the bean crop on such soils. As lime and gypsum require a considerable time for solution, they should be applied in the autumn previous to sowing, and the other manures in spring. Where the soil is deficient in the inorganic substances required by the bean, the application of one or all of these manures will produce healthier plants than dung alone would do. The growth in the former case might not be so rank, but the produce from a perfectly healthy plant is certainly to be preferred to that from one which is to some extent unsound. Although farm-yard manure may in general be the best manure for beans, yet in cases where the ground is already rich in

organic matter, but deficient in the inorganic substances required by the crop, it is evident that its application will not be attended with such good results as would follow the use of mineral manures, such as lime, potash, magnesia, and soda. On the other hand, when the soil is deficient in vegetable matter, but abounds in mineral substances, the application of such will not be so beneficial as that of organic manures.

Cultivation.—When seeds are committed to the earth they are understood to be sown, but when large seeds, such as those of the bean, are placed in the soil singly by the hand, the process is termed planting by many. Beans are generally sown in drills; these are drawn about $2\frac{1}{2}$ feet apart for the smallest sorts, and 3 feet for the larger. In light soil, and for the larger kinds, the depth of the drills should be about 3 inches; in stronger soils, and for smaller sorts, $2\frac{1}{2}$ inches deep will be sufficient. The beans should be placed about 4 inches apart in the drills, and then covered by returning the soil drawn out of the drill, previously breaking it if too rough. The rows should then be well trodden, rolled, or beaten with the back of the spade, if the ground is not too wet; but if this be the case, it must neither be trodden nor afterwards pressed. Instead of drills, holes may be made at proper distances with a blunt ended dibber, and the seed dropped, pressing it close to the bottom of the hole with the dibber. When the plants appear, and have pushed about 6 inches, some earth should be drawn to the stems, taking care, however, not to cover the surface of the leaves. The ground between the rows must be kept well stirred and clean. When the plants have formed pods on the lower part of the stem, the latter should be topped. It is even advisable to top the early sorts as soon as the first pods can be well distinguished.

Instead of placing the seeds at equal distances in a line, some plant them in patches a foot apart, and three or four beans in each patch. In this way, by tying a strip of matting round the plants forming each patch, the stems are not so liable to be broken by the wind as they are when standing in rows. In exposed situations, those in rows are sometimes supported by twine stretched from end to end of the row.

The preceding is the simple routine for a general crop; but some other particulars have to be noticed, also the modes of obtaining early

and late crops. For the former, some of the early sorts above described, such as Marshall's Early Dwarf Prolific, or the Early Mazagan, should, of course, be selected. For these, a warm border in front of a south wall should be chosen, or advantage may even be taken of a border in front of a very close well cut hedge. If very early produce be required, small sowings of these sorts may be made in the end of October, or beginning of November, and another in December for succession, or in case of accident to the previous sowing. If the winter is mild, the plants will require little or no protection; but if likely to be severe, a coat of litter or leaves, or a mixture of both, should be put between the rows to keep the ground from freezing.

As beans, however, transplant well, their safety through the winter may be insured by sowing or dibbling, in November or December, an early sort, about 2 inches apart, in rows from 4 to 6 inches asunder, in some rather light soil and warm situation, where they can be easily protected in severe weather by means of frames, hand-glasses, straw screens, mats and hoops, or similar contrivances. In protecting, care must be taken that the plants do not suffer from want of air and light. They will be fit for transplanting into a warm border in February, when they may be planted out if the weather is sufficiently mild, or as soon afterwards as possible. The plants may be planted in rows, not more than 2 feet asunder, as, in order not to crowd their roots in transplanting, they require to be further apart in the rows than is recommended for the seeds. The plants should be placed fully as deep in the soil as they were before removal, and they should be afterwards managed by drawing a little earth to the stems, and lopping, as previously directed for the main crop. For succession, some of the Early Mazagan, or Marshall's Early Dwarf Prolific, and Long Pod, should be sown in January and again in February; Windsor and Green Windsor, with some Long Pods, in March for the principal crop, and again in April and May for succession. For a late crop, the Long Pod, and Dutch Long Pod, should be sown in June, or the beginning of July.

To obtain a very late crop, after gathering the summer produce of the Long Pod in a young state, let the soil be well watered, if dry, and in two or three days after the watering, let the stems be cut down to within a few inches of the ground. Fresh shoots will soon push, and

a better very late crop will be produced than if seeds had been sown late for the purpose. If a late crop is a very special object, then the plants intended to produce it should be cut down when in flower.

Steeping the seeds of beans accelerates their vegetation, and may be performed with advantage for the main crops. Those sown before or in winter, will acquire enough of moisture for their vegetation. By some experiments on seed-steeping, made by Professor Solly in the garden of the Horticultural Society, it was found that beans steeped in water not only came up more quickly than those not steeped, but that the plants from steeped seeds maintained to the last their superiority over those from seeds not steeped, all other circumstances being precisely the same.

The season in which the experiments were made was a dry one. A quantity of beans of the same sort was selected as equally as possible, and divided into parcels of 150 each; one of these parcels was not steeped, the others were soaked in water and different solutions. For the experiment, saturated solutions of pure nitrate of soda, chloride of calcium, sulphate of magnesia, muriate of ammonia, phosphate of ammonia, and common salt were made, and diluted with nine times as much water.

The following is the result, as regards the number of plants which appeared above ground at the end of a fortnight, out of 150 seeds steeped in solutions of the above substances:—

Nitrate of soda,	0
Chloride of calcium,	0
Sulphate of magnesia,	13
Muriate of ammonia,	0
Nothing,	2
Phosphate of ammonia,	1
Water,	56
Common salt,	0

From the above it appears that water had a good effect, and next to it, sulphate of magnesia; the other solutions appear to have produced little or no effect. The seeds may be kept in steep for twelve hours or longer, according to their state of dryness.

Gathering.—Some prefer the beans when very young, or when the seeds have attained only one-fourth of their natural size. They should at all events be gathered before they appear black-eyed, that is, black at the *hilum*, or point of attachment to the pod. A portion, however, should be allowed to get older, in case they should be wanted for soups.

To save Seed.—The sorts of which seeds are intended to be saved, should be sown in the end of February; and as the best seeds are those in the first formed pods, none of these should be gathered for cooking green, although those produced afterwards near the top may be taken with advantage to those which are left below to ripen. When the leaves become withered and blackish, the stems should be pulled up, tied in small bundles, and set upright, where they will dry by exposure to the sun and air. The seeds will keep good for two years, after which time they are not to be depended on, though some will retain their vegetative powers for five years or more. Seeds that have been long successively saved from plants grown in the same soil and situation, are liable to degenerate. It is therefore advisable to obtain seed occasionally from a different soil and climate—from France, for example.

Insects, &c.—The bean is subject to the attacks of many enemies. Mice eat the seeds deposited in the ground in autumn and winter, but they may be trapped or prevented from doing much mischief, by covering the drills with rough sand, or by sowing chopped furze along with the seed in the drills. But the most destructive agent is the “blight,” caused by the attacks of the dolphin-fly, or collier (*Aphis fabæ*), which attacks the leaves when the beans are beginning to swell in the pods. Commencing at the top, this insect works downwards, till at last nothing remains but black stalks and pods arrested in their development. The only effectual remedy consists in cutting off the tops of the plants, as soon as the insect makes its appearance, and burning them. The seeds are also sometimes attacked in the ground by the snake millipedes (*Juli*), which bore into them, and cause them to rot; and the leaves are eaten by the curculios, or weevils (*Sitona lineata* and *Otiorhynchus picipes*), as well as by the caterpillars of the Y-moth. Humble-bees pierce the blossoms, and frequently render the pods abortive; and the beetles of *Bruchus granarius* and *B. flavimanus* lay their eggs in the flowers, and the larvæ which are produced attack the seeds, which may, however, be freed from them by steeping in brine.

BEET (*Beta*, L.—Pentandria Digynia, L.; Chenopodæ, D. C.; Chenopodiaceæ, Lindl.)—Of this, varieties of two species, namely, *Beta vulgaris* and *Beta Cicla*, are cultivated; the sea-beet (*Beta maritima*) is also sometimes

grown for its leaves, which form a good substitute for spinach.

I. BEETROOT (*Beta vulgaris*, L.) is a hardy biennial, a native of the sea-coast of the south of Europe. From it, numerous varieties have originated, and infinite shades of difference may be found among seedlings annually raised from those in cultivation; hence, new designations are given to sorts so closely allied as to be scarcely worth distinguishing.

The principal garden varieties are:—

A.—Red.

1. RED CASTELNAUDARY BEET—syn. Betterave rouge de Castelnauary, La petite rouge de Castelnauary.—“It derives its name from a town in the province of Languedoc, in France, where the soil is particularly adapted to the growth of these vegetables, and where this variety, which is so much esteemed in France for its superior flavour, which they compare to that of a nut, was originally produced. The root grows within the earth, the leaves are thickly clustered round the crown, spreading on the ground; the longest of the foot-stalks do not exceed 3 inches; these, and the veins of the leaves, are quite purple; whilst the leaves themselves are green, having only a slight stain of purple, which proceeds from the borders of the veins; the root is little more than 2 inches diameter at the top, tapering gradually to the length of 9 inches, and is covered with fibres of different sizes; it is of a deep purple colour, exhibiting dark rings. It preserves its fine colour when boiled, is very tender and sweet, and looks delicate when sliced. This is certainly more distinct, as a variety, than any of the others; it is smaller in its whole habit, and as it occupies much less space in the ground, may be sown closer than the other kinds usually are.”—(*Horticultural Transactions*, vol. iii. p. 276.) The above are the true characters of this excellent variety; but of late years it appears to have somewhat degenerated, for the stalks have a yellowish tinge, as if crossed with the Yellow Castelnauary.

2. DWARF RED.—Larger than the preceding, but in habit of growth much resembles it. The flesh is crimson, and, when boiled, of a deep pink, tender and free from fibre.

3. LARGE-ROOTED RED BEET—syn. Betterave rouge grosse, Betterave grosse rouge ordinaire.—Usually grows about half above ground; leaves erect; foot-stalks nearly a foot

in length, and, together with the veins of the leaves, deep red. Root cylindrical, about 4 or 5 inches in diameter. Internal colour bright red, with white concentric rings; it boils soft of a bright pink, showing, however, the white rings; rather coarse; flavour sweet. It is the variety most cultivated in France, being more robust, and better adapted for general cultivation than the finer sorts.

4. LONG-ROOTED RED BEET.—The root of this grows mostly underground, tapers like a carrot, and, in good soil, attains the length of 15 or 18 inches, throwing out strong fibres, but no fangs; the top is upwards of 3 inches in diameter; flesh bright scarlet, deep pink when boiled; sweet, but rather fibrous.

5. BARROTT'S NEW CRIMSON BEET.—The leaf-stalks of this have a yellowish tinge. The root is somewhat larger than those of the Castelnauary, and not apt to fork; flesh dark crimson. An excellent variety.

6. WHYTE'S BLACK, OR WHYTE'S LARGE DARK RED BEET.—This is the darkest coloured sort in cultivation, but it is rather coarse.

7. TURNIP-ROOTED RED BEET—Betterave rouge ronde précoce.—The leaves not numerous; foot-stalks 5 or 6 inches long, pale, tinged with purple. The root is chiefly below ground, but the upper part is exposed, and of a brownish colour. The flesh is purplish red, with irregular rings of a lighter colour. The root boils to a pink colour, coarse in appearance, but tender and free from fibres; early in the season it is better flavoured than the other kinds.

8. BASSANO BEET.—In form, this is very like the preceding, being flat and round; but it differs in being white internally. The skin is reddish, flesh white, with concentric bright rose-coloured zones or rings. M. Audot states, that “the Bassano beet appeared to be the same as that which he met with in the month of June, in all the markets in the north of Italy, from Venice to Genoa. It was then from 2 to 2½ inches in diameter, young and tender, and it preserved its rose-coloured zones after it had been cooked.” He adds, “that at Venice it is called Betterave de Chioggia, from the name of the place whence it is supplied to the Venetian market. This sort is not well adapted for winter use, but it is very good for summer and autumn consumption; and from its forming its root chiefly on the surface, it may be grown on thinner land than that required for the deep-rooting kinds.

B.—*Yellow-rooted.*

9. **SMALL YELLOW BEET**—syn. Yellow Castelnaudary Beet, Betterave jaune de Castelnaudary.—The type of this is thus described in the *Transactions of the Horticultural Society*:—"The root grows entirely in the ground; the leaves spread on the surface, the outside ones being on foot-stalks about 4 inches long; the inner ones are shorter, numerous, of a dark green colour, and rather waved on the edges; the foot-stalks are green rather than yellow; the root is nearly 3 inches diameter at the top, and extends about 8 inches into the ground; it is very similar to the other yellow kind, except in size, and its rings are consequently less coarse; in colour it exactly corresponds. When boiled it is tender, yet firm and very sweet, being unquestionably the most preferable variety that can be grown for the table, though its colour is not so agreeable to the eye."

10. **LARGE YELLOW BEET**—syn. Betterave jaune grosse, Betterave jaune à sucre.—This grows mostly above ground. The foot-stalks of the leaves and the veins have a bright yellow tinge; the leaves themselves are of a dark lurid green, without any admixture of red; the outside of the root is of a pale orange, the inside a lemon colour. The flesh is very sweet, but rather coarse, and on this account much inferior to the preceding. This was the sort from which the French principally manufactured their sugar during the war in the beginning of the present century, when they were excluded from the trade of the West India Islands.

11. **ROUND YELLOW-ROOTED BEET**.—Root rather small, well-formed, and good. According to the *Bon Jardinier*, it is the earliest of all the varieties.

C.—*White or Pale Green.*

12. **WHITE SILESIAN BEET**—syn. White Silesian Sugar Beet, Betterave blanche de Prusse.—Root very large, a little elongated, growing mostly below the surface of the ground. Skin white or greenish white; flesh white. This variety is employed almost exclusively for the extraction of sugar, of which it contains from 5 to 12 per cent. The average proportion of sugar may be assumed at 10 per cent., but the actual quantity obtained in the factories seldom exceeds 5 per cent.

The composition of two varieties of beet has been ascertained, by Mr. Cameron, to be as follows:—

	Long Red.	Short Red.
Water,	85.18	84.68
Gum,	0.67	0.50
Sugar,	9.79	11.96
Caseine,	0.39	0.26
Albumen [?],	0.09	0.18
Fibre, pectin, and pectic acid,	3.08	3.31
	99.20	100.89

The following is the composition of the ashes, as ascertained by Messrs. Way and Ogden:—

	Yellow Globe.		Long Red.	
	Bulb.	Leaf.	Bulb.	Leaf.
Potash,	23.54	8.34	29.05	27.53
Soda,	19.08	12.21	19.05	5.83
Lime,	1.78	8.72	2.17	9.06
Magnesia,	1.75	9.84	2.79	9.10
Oxide of iron,	0.74	1.46	0.56	0.48
Carbonic acid,	18.14	6.92	21.61	6.11
Phosphoric acid,	4.49	5.89	3.11	4.39
Sulphuric acid,	3.68	6.54	3.31	6.26
Chloride of sodium,	24.54	37.66	14.18	29.85
Silica,	2.22	2.35	4.11	1.35
	99.96	99.93	99.94	99.96
Percentage of ash,	1.02	1.40	1.00	1.91

Beet requires a situation fully exposed to the light, for, however good the soil may be, the plants will not thrive well if in any way shaded by trees. A tolerably rich open loam, or a sandy loam, produces the cleanest roots and the best crops. Ground that has been manured for a previous crop will not require to be again manured for beet. It should, however, be trenched in winter two spades deep, throwing the soil in ridges, in order to expose it to the action of the weather. Advantage should be taken of dry weather to level down the ridges, and dig the whole regularly over just before sowing.

If manure is necessary, it should be applied in trenching, putting it down a foot or so below the surface. It appears, from the above analyses, that beet contains a very large percentage of chloride of sodium, or common salt, and it may therefore be concluded that salt will prove very beneficial as a manure for this plant, especially in inland situations. It is accordingly found that salt has a decided effect in promoting the growth of beet; but it

should only be applied in moderate quantities, as both it and ammoniacal manures, when too liberally given, have the effect of increasing the bulk of the produce at the expense of its quality. Some manures produce a marked effect even on those kinds of beet-root which do not naturally grow to a large size. In some experiments made in the garden of the Horticultural Society, with various manures applied to ground sown with Castlenaudary beet, Potter's guano produced the heaviest crop. This compound was applied at the rate of 4 cwts. 5 lbs. per acre, or little more than $2\frac{3}{4}$ lbs. per rod; it was mixed with about seven parts of fine soil, and scattered along the bottoms of the drills previous to sowing. The rows were 15 inches apart, and the plants were thinned out to 9 inches apart in the rows. The weight of roots produced was at the rate of fully 28 tons per acre; whilst the produce from rows that had no manure was at the rate of 15 tons 15 cwts. The same quantity of the best Peruvian guano, applied in the same way, produced 22 tons 13 cwts. of roots.

In most localities the main crop may be sown in the third week of April. The precise time, however, depends on the soil and situation. In some soils the plants are apt to run to seed in the same season; therefore, where this is found to be the case, the sowing should be made later than in soils where the plants are not subject to run. The market gardeners near London sow their beet in the first week of May; for if sown as early as some recommend, the roots become too full of fibre, and are not so tender as those sown later. On the other hand, it may be sown too late to acquire its proper size and flavour. The medium between these extremes is the proper time for sowing the principal crop, and this, we presume, will generally be found to correspond with the period above recommended. In gardens where early crops must be raised, it will be advisable to sow some early kind at the end of February, or in the first week of March; or at this time plants for transplanting may be raised in a frame, where the heat is very slight. For succession, a few more rows, according to the demand, may be sown at the end of March.

Previous to sowing, the seed should be steeped for about twelve hours in water of a temperature between 50° and 60° . The seeds having been taken out of steep, and allowed

to drain, so as not to stick to each other, should be sown whilst their surface is still damp. Beet-root is best sown in drills about $1\frac{1}{2}$ inch deep; these for the smaller kinds, such as the Castlenaudary, should be about 16 inches apart; and the plants should be thinned out to 9 inches apart in the row. The large sorts may have 18 inches between the rows, but still not more than 9 inches from plant to plant in the row. If we desired to grow beet-root to a large size, we might have the rows 18 inches or 2 feet apart, and the plants as much as 12 or 15 inches distant from each other in the rows; but large roots are not desirable for table, and it is better to have two of medium size grown at 9 inches apart, than one of perhaps double the size from twice the space. As a square foot of ground should afford plenty of nourishment to produce a root large enough for table, we may therefore limit the area for each plant to that extent. If we make the rows 16 inches apart, and thin the plants to 9 inches apart in the row, each plant will have a space equal to a square foot. Such, of course, would also be the case if the rows were 12 inches apart, and the plants the same distance from each other in the row; but it is preferable to allow a greater space between the rows, than between the plants in the row; for by this arrangement the leaves have better scope to grow to each side, and the plants so situated grow better than those which have an equal but rather limited space in all directions—whilst the ground can also be more easily stirred and kept clean.

When the plants are about 2 inches in height, they should be singled out where two come up close together; and when they have made six leaves, they should be finally thinned to the proper distance. At this age they should be transplanted into any blanks that may be found in the rows. It is a good plan to sow a small bed for the purpose of making up deficiencies; or in some cases the entire crop may have to be transplanted. Great care should be taken not to break the roots in removal, and the principal one should be inserted at full length, and without doubling. Transplantation should, of course, be performed in cloudy weather, and when the ground is moist, either naturally, or by means of watering, but not wet. The ground should be frequently stirred during the summer, watering only when absolutely necessary.

The crop will continue to grow till checked by frost or cold weather. Part of it should be taken up in the end of October or beginning of November. A few days previous to the taking up of the roots, the leaves should be trimmed off several inches above their bases. In taking up, a trench must be dug out along the first row to be taken up, to the full depth of the roots; from these the earth should be carefully removed, in order not to break the fibres, for loss of colour will result from their being broken. The roots may then be housed, by laying them slanting among moderately dry soil, so that the herbaceous part only of the crown may be exposed. Some being taken up in case of severe frost, means should be adopted to protect those remaining in the open ground; for those preserved in this way have a much fresher flavour than those which are housed. The beet will stand a sharp frost tolerably well, provided the ground is not allowed to get frozen, and this should be prevented by leaves, fern, litter, or other means at command.

To save Seed.—For this purpose a row, or part of a row, according to the quantity of seed required, may be sown in an open situation, and the plants thinned out to a foot apart; only those which appear the finest and true to the variety should be preserved. These should be well protected from frost in winter, and their stems secured in the following season from breaking by the wind. Instead of sowing on purpose to raise plants for bearing seeds, a few roots of the finest of the main crop may be taken up and replanted in spring.

II. LEAF BEET (*Beta Cicla* L.) is a hardy biennial, a native of the sea-coasts of Spain and Portugal. It is cultivated for the leaves and leaf-stalks, but chiefly for the latter; for, as regards the roots, they are hard, much divided, and unfit for cooking. The thin part of the leaves is sometimes put into soups, together with sorrel, the acidity of which it corrects; the stalks and mid-ribs, when peeled, are usually boiled and served up in the same way as asparagus or sea-kale; and they are sometimes stewed with sauce.

The varieties are:—

1. GREEN or COMMON LEAF-BEET.
2. WHITE or SILVER LEAF-BEET.
Poirée à carde blanche.
3. YELLOW-STALKED LEAF-BEET.
Poirée à carde jaune.

4. RED-STALKED LEAF-BEET.

Poirée à carde rouge.

5. CURLED LEAF-BEET.

Poirée à carde frisée.

Of the above sorts, the Red-stalked and Yellow-stalked are very beautiful, owing to their bright colours; but the White, or Silver leaf-beet is esteemed the best. The leaves of the fifth sort are curled like those of a Savoy, and have broad white mid-ribs.

Any good garden soil will suit the leaf-beet. The seed should be steeped previous to sowing, like those of the other beets; and it may be sown in drills 18 inches apart, and about 1½ inch deep; in March for autumn and winter use, and again in August for a spring supply. When the plants are a few inches high, so that those likely to make the best growth can be distinguished, they should be thinned out to 9 inches or a foot apart, according to the richness of the soil, more room being allowed in rich ground. Some, however, should be left at half that distance, to make up any vacancies that may occur. The ground should be kept clean, and occasionally stirred between the rows, taking care not to injure the roots. In dry weather, plenty of water should be given to promote the succulence of the leaves. When sown in autumn, the plants should be protected with litter during very severe weather. The outside leaves should be the first cut for use; the others will come in for succession.

Insects.—The roots of young plants sometimes suffer greatly from the grubs of *Agrotis segetum*, *A. exclamationis*, and *Tipula oleracea*. Hand-picking is the only way of getting rid of these. In France and Ireland, but never in England, according to Mr. Curtis, whole crops are destroyed by the larvæ of the beet carrion-beetle (*Silpha opaca*), which devour the young leaves; these are also attacked by the turnip-fly (*Altica nemorum*), by the larvæ of *Cassida nebulosa*, and *Anthomyia betæ*.

BORAGE (*Borago officinalis*, L.; Pentandria Monogynia, L.; Boragineæ, D. C.; Boragina-ceæ, Lind.)—is an annual plant, a native of England, or naturalized in it. Its pretty white, reddish, or blue flowers, are employed for garnishing salads, and in cool tankards; the young leaves are used as a salad, sometimes as a pot-herb; they are also pickled.

It grows in almost any soil, but prefers a dry one. The seed may be sown at any time in the spring, summer, or autumn. A sowing

should be made in March, and if a constant succession is required, a small quantity may be sown monthly from that time till September. The seeds should be sown where the plants are to remain, either broad-cast and raked in, or in drills 6 or 8 inches apart, only a light covering of earth being given. In dry weather, the seed-bed should be frequently watered, and when the young plants are well established they should be thinned out to 8 inches apart.

Seed is easily saved by cutting off the flower-stalks a little before the seed is so ripe as to drop in handling, and drying them on a cloth; if the seed is allowed to ripen on the plant it will sow itself.

BORECOLE, or Kale (*Brassica oleracea acephala*, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, P. C.; *Brassicaceae*, Lind.)—The borecoles constitute one of the hardiest divisions of the *Brassica* tribe, and on this account they are very important for northern climates, for in such they yield the principal supply of winter greens to the generality of the inhabitants. Being so universally cultivated in most European countries, many of the sorts have acquired a multiplicity of names, as will be seen from the following list, which comprises the principal sorts and their synonyms:—

1. **DWARF GREEN CURLED**—syn. Dwarf Curled Kale, Very Dwarf Green Curled, Dwarf Winter Curled, Scotch Kale, Green Scotch Kale, Dwarf Curlies, French Dwarf Curled, Canada Dwarf Curled, Labrador Kale, Green Borecole, Dwarf Green Borecole, Chou frisé vert à pied court, Chou frisé à pied court.—By one or other of the above names this is known to every one. The Canada Dwarf Curled was found to represent exactly the finest Dwarf Curlies grown many years ago in some parts of Scotland, the plants being very dwarf and closely curled. This sort of borecole is very hardy, and the plants from their dwarf habit are liable to be completely covered with snow, and thus protected they are often preserved quite fresh when the taller kinds, having their tops above the snow, are either completely destroyed by frost, or rendered so tough as to be unfit for use.

2. **TALL GREEN CURLED**—syn. Tall German Greens, Tall Scotch Kale, Tall Green Borecole, Tall Greens, German Tall Curled Greens, Green Winter Greens, Chou frisé vert du Nord, Chou frisé vert du Nord grand, Chou frisé, Chou frangé du Nord, Chou frisé non

pommé, Chou frisé d'Allemagne, Grosser Grünkohl, Krausser Grünkohl, Nordischer Grünkohl.—Height usually from 2 to 3 feet; but 2 feet is the preferable growth. The plants are capable of enduring a considerable degree of frost, and, like the preceding, it affords the best greens from the time that the first frost has mellowed its flavour, to the middle of February. The quality of these greens is improved by a moderate degree of frost, but deteriorated by dry frosty winds.

3. IMPERIAL HEARTING or CABBAGING KALE.

This is a new sort, which very much resembles the Dwarf Green Curled in the nature, colour, and general appearance of the leaves; the heart leaves, however, fold over each other, somewhat like those of a cabbage, but owing to the curls of the margin, of course, not so compact. The quality is excellent.

4. **PURPLE BORECOLE**—syn. Red Borecole, Purple Kale, Tall Purple Kale, Purple Winter Greens, Brown Kale, Curled Brown Kale, Curled Red Kale, Braunkohl of the Germans.—This in its formation and habits differs little from the Tall Green Curled, but the colour is deep purple; as the leaves enlarge they have an inclination to become green, but the veins still retain the purple hue.

The Purple borecole is very hardy; and the Germans esteem it much, probably from its being adapted to withstand the severity of their winters. They dress it with a rich sauce, and sometimes mix chestnuts with it, stewing them together.*

5. **VARIEGATED BORECOLE**; syn. Variegated Kale, Variegated Plumage Kale, Chou Plume, Chou frisé panaché, Aigrette, Chou frisé vert et rouge, Bunt Plumage Kohl, Federkohl.—A sub-variety of the Purple borecole, having the leaves beautifully variegated; sometimes green and yellowish white, green and purple, bright red, purple, or green. It is occasionally employed for garnishing; but it is very good cooked after frost. It is not quite so hardy as the Purple borecole.

* The following note at the description of this sort is given in the *Transactions of the Horticultural Society*, vol. ii. p. 312:—"German receipt for dressing Brown Kale.—Take $\frac{1}{4}$ lb. of butter, put it over the fire till it is quite brown, then add 1 pint of veal broth to it while it is in a hot state, season it with a little pounded mace, salt, and lump sugar. Into the broth thus prepared, put the hearts and tender leaves of the kale, after they have been washed clean; let them stand till they become quite tender, and reduce the liquor as low as you can without burning the kale, before you serve it."

Dwarf Purple Borecole, or *Chou frisé rouge à pied court*, and the *Dwarf Variegated*, are merely sub-varieties of the two preceding, distinguished by their dwarfer habit of growth.

6. BUDA KALE—syn. Prussian Kale, Buda Greens, Russian Kale, Hamburgh Kale, Anjou Kale, Manchester Kale, Camberwell Kale, Asparagus Kale, Duke of York's Kale, and so closely allied as not to be worth distinguishing from it, are the Jerusalem Kale, Delaware Greens, Delaware Kale, Ragged Jack, Dwarf Feathered Kale, Jagged Kale, Chou à feuille de chêne.—The Buda kale is not so tall as the Purple borecole; very hardy; leaves purplish, somewhat glaucous, cut and fringed. It has been blanched in some cases like sea-kale.

7. WOBURN PERENNIAL KALE is a tall variety of the Purple borecole, with foliage very finely divided or fringed. The plant lasts many years, and may be propagated by cuttings, as it neither flowers readily nor perfects well its seeds. Its produce at Woburn is stated to have been more than four times greater than that of either the Green or the Purple borecole, on the same extent of ground. The weight of produce from 10 square yards was 144 lbs. 10 oz.; but some of the large kinds of cabbages and Savoy's will exceed this considerably, and prove of better quality. The Woburn Perennial kale can, therefore, only be recommended where the climate is too severe for the more tender kinds of the cabbage tribe.

8. TREE CABBAGE—syn. Great Cow Cabbage, Cæsarean Borecole, Cæsarean Cabbage, Waterloo Cæsarean Cabbage, Chou en arbre, Grand Chou à vache, Chou cavalier, Chou à chèvre, Grand Chou vert, Chou vert de Tourraine, Baumkohl, Grosser Kuhkohl.—This grows to the height of 6 feet, and in La Vendée and Jersey it is said to attain the height of 12 feet or upwards. The leaves are large, smooth, or but slightly curled; its sprouts are said to be good when cooked, and cottagers might grow it with advantage in some cases, as it affords a supply for cattle. Its merits, however, appear to have been greatly over-rated, for, when tried in this country against other varieties of cabbages, its produce was nothing extraordinary.

9. THE THOUSAND-HEADED CABBAGE—syn. Chou à mille têtes, Chou à mille têtes du Poitou, Chou branchu du Poitou—is allied to the preceding, but does not grow so tall; it sends

out numerous side-shoots. On the whole it is preferable to the Tree cabbage.

10. FLANDERS KALE, or Caullet de Flandre, is a tall growing kind, distinguished from the Tree cabbage by its purplish foliage.

11. COCK'SCOMB KALE, or Chou à feuilles prolifères, produces sprouts along the ribs on the surface of the leaves, but it is not of much value.

Borecole, it is well known, will grow in any garden soil; of course, like all the cabbage tribe, it likes plenty of manure. It will do very well on a north border, and such is frequently occupied with this crop; but for that situation, and perhaps we may say for all others in a garden, the Dwarf Curled is the most suitable. Nothing is more unsightly than tall borecoles, hiding perhaps 3 feet or more of the wall, and rendering it so far useless for trees. The main crop of the first sort should be sown in the first week of April, or, in the northern parts of the kingdom, in the third week of March; and some for a succession should be sown in the first week of May. Another sowing may be made in August, to be planted in spring. A sowing of the Buda Kale for late spring use should be made in the last week of August, and transplanted in the end of September. The Tree cabbage, Thousand-headed cabbage, and the Flanders kale, if required, should be sown early in spring, or, preferably, in the north in the first week in August.

The plants should not be allowed to get overcrowded in the seed-bed, as is often the case in cottage gardens, if not occasionally in others. Ground may not be in readiness to receive the plants when they are fit for transplanting in consequence of its being occupied by some other crop; if so, there can be no great difficulty in relieving the over-stocked seed-bed, by pricking out a portion in some spare corner where they will enjoy light and air, and moisture should be duly supplied till they can be finally planted out. By these means, a healthy stock, capable of producing more succulent greens than could be expected from a plantation formed of lingering ill-conditioned plants, will be insured. The distance of planting depends partly on the variety, and partly on the nature of the soil, the large growing sorts, of course, requiring more space than the smaller ones, and the whole of the sorts more in rich soil than in that which is comparatively poor. In general,

however, the first six sorts may be planted in rows 2 feet apart, and 18 inches from plant to plant in the rows. Tree cabbage and the Thousand-headed cabbage require to be planted 3 or 4 feet apart each way. The subsequent culture consists in watering till the plants strike root, if the weather proves dry, hoeing and stirring the soil between the rows, and as the tall sorts advance in growth some earth may be drawn to their stems. Caterpillars should be shaken or picked off and destroyed. Buda kale may be blanched and used like sea-kale. In gathering, the hearts of the Dwarf and Tall borecole should be cut for use, and the remaining stem will push fresh sprouts. The cut should be slanting in order to throw off the rain.

To save Seed.—This is an easy matter; but to save the varieties true to the kind is frequently difficult, notwithstanding the greatest care, the different varieties of the Brassica tribe being so liable to cross in consequence of the pollen being carried from one variety to another by bees, flies, or other insects, or even by the wind. It is therefore not sufficient to net the seed-plants, so that bees cannot reach the flowers; it is even questionable whether the reverse of what is intended is not occasioned by so doing, for the bees in hovering above the netting will lose some of the pollen brought on their hairs from flowers of other plants of the cabbage tribe, and that falling amongst the plants frequently effects a cross. It has been well ascertained, that if a single plant of borecole is left for seed the flowers are much more liable to be impregnated with the pollen than when there are several; and when a large number are planted together the seeds obtained from them are generally true, for then the bees come direct for their load, without stopping here and there. By selecting plants of the best characters, and planting a dozen or so together, we have known a very fine Dwarf Curled borecole saved perfectly true for many years. The plants for seed should be taken up early in spring, and planted rather deeply in a spot well exposed to the sun, and rather sandy than stiff. They should be watered moderately so as to keep them in a healthy state, and the stems should be supported to prevent breakage by the wind. When the seeds are ripe, they should be rubbed out, cleaned, and dried, after which they may be put into canvas bags, and hung up in a dry place.

BROCCOLI (*Brassica oleracea* var. *Botrytis cymosa*, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.) is a hardy biennial, though not so hardy as many others of the Brassica tribe; a native of Italy, and elsewhere on the shores of the Mediterranean. Some think that the broccoli has been derived from the tall open cabbages or greens, but from these it differs in many respects, especially in the glaucous colour of the leaves. The difference between some of the white broccolies and the cauliflower is scarcely perceptible. Miller, indeed, supposes, in his *Gardener's Dictionary*, that the broccolies known in his time were derived from the cauliflower, which, he states, was imported from the island of Cyprus.

The varieties of broccoli are now exceedingly numerous, and much confusion has existed among them, as will be seen from the following list of their names and synonymes. They may be classed as follows:—

I. PURPLE AND GREEN.

1. EARLY PURPLE CAPE.
Purple Sicilian.
Purple Silesian.
Grange's Early Cape.
Blue Cape.
Violet nain hâtif.
2. GREEN CAPE.
Autumnal Cape
Improved Cape.
Maher's Hardy Cape.
3. SPROUTING.
Asparagus Broccoli.
Italian Sprouting.
Grange's Early Purple Sprouting.
Autumn Sprouting.
Early Branching.
North's Early Purple.
4. GREEN CLOSE-HEADED.
Green Close-Headed Winter.
Late Green.
Late Hardy Green.
Siberian.
Late Green Siberian.
Dwarf Roman.
5. LATE DWARF PURPLE.
Dwarf Danish Purple.
Dwarf Swedish.
Dwarf Hardy Siberian.
Dwarf Close-Headed Purple.
Late Purple.
Italian Purple.
Cock'scomb.
6. DANISH OR LATE GREEN.
Dwarf Danish.
Late Danish.
Latest Green or Siberian.
7. DWARF BROWN.
Late Danish.

Late Dantzic.
Late Brown.
Lewisham Brown.

II. CREAM-COLOURED AND SULPHUR.

8. CHAPPELL'S LARGE CREAM-COLOURED.
Chappell's New Cream-coloured.
9. PORTSMOUTH.
Cream-coloured.
Southampton.
Belvidere.
Maher's New Dwarf.
10. SULPHUR.
Brimstone.
Late Brimstone.
Edinburgh Sulphur.
Fine Late Sulphur.
11. MITCHELL'S NE PLUS ULTRA.

III. WHITE.

12. GRANGE'S EARLY CAULIFLOWER BROCCOLI.
Grange's Early White.
Grange's Impregnated.
Hopwood's Early White.
Marshall's Early White.
White.
Invisible White.
Bath White.
Italian White.
Blanc d'Italie.
13. COCK'S EARLY WHITE.
14. GILLESPIE'S.
15. EARLY WHITE.
Autumn White.
Devonshire White.
Neat House.
16. HAMMOND'S WHITE CAPE.
17. STEWARD'S EARLY WHITE.
18. ADAM'S SUPERB EARLY WHITE.
Adam's New Early White.
19. SNOW'S SUPERB WHITE WINTER.
20. WHITE CAPE.
21. SPRING WHITE.
Cauliflower Broccoli.
Large Late White.
Close-headed White.
Naples White.
Neapolitan White.
22. COCK'S LATE WHITE.
23. KNIGHT'S PROTECTING.
Hampton Court.
24. MELVILLE'S SUPERIOR LATE WHITE.
25. ELLETSON'S GIGANTIC LATE WHITE.
Elletson's Mammoth.
26. MILLER'S LATE WHITE.
Miller's Dwarf.
27. WILLCOVE.
Late Willcove.
28. WARD'S SUPERB LATE WHITE.

Other sorts of good repute are the Early Malta, Sutton's Superb Early White, Dilcock's Bride, Winter Imperial White, Sumner's Late White, Comming's Reliance, Victoria White, and Danecr's Late Pink Cape.

EARLY PURPLE CAPE.—This grows from a

foot to 18 inches high. Leaves nearly entire, erect, waved; veins and mid-rib stained with purple. Heads middle-sized, compact, purplish green, the whole becoming green when boiled. Sow first and third week in May, for use in September and October. A longer succession—namely, till January—may be obtained if required, from a sowing in the second week in June.

GREEN CAPE.—Leaves long, narrow, veins and mid-ribs green. Head greenish, generally covered by the leaves; comes into use in October and November, from sowings in the middle of May, and in December if sown in the second week in June.

SPROUTING.—A strong-growing hardy sort, from 2 to 3 feet high. Leaves spreading, much indented, of a purplish green. The head is of a deep purple; the first one close, others smaller sprout from the axils of the upper leaves. If sown in April it produces heads or sprouts fit for use in November. After the first head is cut out a succession of sprouts is produced through the winter. Near London the principal sowing is, however, made in the first or second week of May; but if the ground intended to be planted is not likely to be cleared of the previous crop in time to receive the broccoli plants sown in the beginning of May, before they get too old in the bed, the sowing must be deferred till the end of May or beginning of June; and from these late sowings, heads or flower sprouts will come in for use in April.

GREEN CLOSE-HEADED.—The plants are dwarf and hardy, leaves large, waved, veins white. Heads middle-sized, growing exposed, of a greenish colour. Sown in the third week of May, it produces a succession of compact heads from November till the end of February.

LATE DWARF PURPLE.—Very dwarf and hardy. Leaves short, dark green, deeply indented. Heads small, conical, deep purple, becoming fit for use in May. Sow in the second or third week in May.

DANISH or LATE GREEN.—Leaves long, narrow, much undulated. Heads tolerably large, compact, exposed, and of a greenish colour; fit for use in April and May. The hardiest and best for withstanding severe winters. Sow in the second week in May.

DWARF BROWN.—Leaves dark green with white veins. Heads exposed, yellowish brown. Sown about the middle of April, it comes in for use from March till May.

CHAPPELL'S LARGE CREAM-COLOURED.—A very large sort, which comes in earlier than the Portsmouth, and continues to produce throughout the winter. Sow about the middle of April and first week in May.

PORTSMOUTH.—Leaves large, broad, with white veins, spreading, but the centre ones partially cover the flower or head, which is very large, and of a buff or cream colour. It is fit for use in March and April. A hardy sort for its size, and requires to be sown in the first or second week in May.

SULPHUR.—Leaves, with long stalks. Heads large, compact, somewhat conical, sulphur-coloured, sometimes tinged with purple. A hardy sort, in use in April and May. Sow in second or third week in May.

MITCHELL'S NE PLUS ULTRA.—Hardy, and of dwarf habit. Leaves smooth, glaucous, protecting the head, which is large, compact, cream-coloured. Sow middle of March and middle of April.

GRANGE'S EARLY CAULIFLOWER BROCCOLI.—This is the earliest of the white kinds, forming a succession to the late crop of cauliflowers. Sown in the first and third weeks of May, beautiful heads will be produced in October, November, and December. In the southern part of the kingdom it may be sown in June for use in January; but it is better to trust to a hardier sort for a supply at that period of the season.

COCK'S EARLY WHITE.—This is a very excellent sort for autumn use. A small sowing should be made about the 1st of May, and the principal sowing about the 10th of that month.

GILLESPIE'S WHITE.—A fine early autumn sort. Sow first week of May and June.

EARLY WHITE.—Plants tall, with erect, dark green leaves, which are nearly entire. Heads close in texture, and of a very white colour. Season—November, December, and January.

HAMMOND'S WHITE CAPE.—This is a fine white autumn sort, but may be obtained in long succession if sown in April, and monthly till June; or it may be had at all seasons if treated the same as the Walcheren cauliflower.

STEWART'S EARLY WHITE.—A sort much esteemed about Edinburgh. Sow first week in May, or, in the north, in the third week in April, for produce in December and January.

ADAMS' SUPERB EARLY WHITE.—A good

autumn sort. Sow middle of April and first week in May.

SNOW'S SUPERB WHITE WINTER BROCCOLI.—Dwarf habit; leaves broad, with short petioles. Heads rather large, very compact, well protected with leaves, white and equal in quality to those of the cauliflower. Sow early in March, first week in May, and middle of June, the produce will be fit for use in November, December, January, and March. If sown in the middle of August, protected if the weather should be severe, and planted out early in spring, they will come in to succeed the spring cauliflowers. Many prefer this sort to Grange's Early Cauliflower broccoli.

WHITE CAPE.—This forms compact heads of medium size. If sown in April and May, it is in season throughout January and February.

SPRING WHITE.—Leaves large, with thick, white veins, encompassing the head so as to render it invisible when fit to cut. The head is of medium size, very white, and is fit for use in April and May. Sow third week in April.

COCK'S LATE WHITE.—A fine close-headed late sort, coming in for use in February and March. The leaf-stalks are somewhat twisted, like those of Knight's Protecting, and, consequently, protect the head. Sow first week in May.

KNIGHT'S PROTECTING.—Amongst the hardiest of the white sorts, and excellent when it can be obtained true; but it is apt to degenerate. The leaf-stalks are peculiarly twisted, so as to encompass and protect the head, which is very large and white. Sow in the third week in April and second week in May.

MELVILLE'S SUPERIOR LATE WHITE is a good hardy late sort. The writer of the calendar in the *Gardeners' Chronicle*, 1847, p. 471, states, that it was the only kind he saved the previous severe winter without losing a single plant.

ELLETSON'S GIGANTIC LATE WHITE.—Stem short; head very large and fine, fit for use in May and June. Sow middle or end of April.

MILLER'S LATE WHITE.—This is an old variety; but is considered by some to be the best late sort if it can be obtained true. It is hardy, and requires to be planted early. Sow middle of April.

WILLCOVE BROCCOLI.—This is a good very late dwarf, and comparatively hardy variety, affording a supply till cauliflowers come in. It derives its name from a small village near Devonport, noted for the last forty years for

producing the latest broccoli, and where this variety is said to be grown in great perfection.

WARD'S SUPERB LATE WHITE. — A new sort, stated to be as large and as white as a cauliflower. Sow in the end of April.

The varieties above noticed are too numerous; but some may wish to try different sorts, in order to ascertain which best suits their soil, climate, and demand.

The general times for sowing have been indicated in noticing the different varieties. Near London the principal crops of the early kinds are sown about the 10th of May, and the late kinds in the second or third week of April. Broccolies closely approaching to the cauliflower, and having like it the disposition to come early into flower, as is the case with many of the autumn kinds, do not require to be sown early. Such are Grange's Early Cauliflower broccoli, and similar early kinds. On the other hand, the Spring White should be sown in the middle or end of April. The seed-beds should be composed of rich light earth, and not such as has been worn out by crops of the Brassica tribe, at least not such as has previously produced unhealthy or clubbed plants. Some fresh maiden loam, well mixed in digging with the soil of the beds, is very beneficial. If dry, the soil should be watered the day before sowing. If the seed has been proved to be good, it should be thinly sown, and it should be lightly covered with some soil from the alleys, made fine, and then evenly raked, and pressed with a light roller or the back of the spade. In some cases, after sowing, it may be advisable to cover the beds with mats, but these must be removed immediately the seeds begin to appear. When the plants come up they should be thinned where too close, and the ground should be stirred with an inch hoe. When they are about 3 inches high, they may be transplanted where they are to remain, if the ground can be cleared from other crops; if not, the plants may remain a week or two longer, taking care to thin if crowding be likely to take place. Should it, however, be found that circumstances will not admit of the ground being cleared before a later period, the plants must be carefully transplanted, to about 4 inches apart, into nursery beds. Early sorts, however, should not be transplanted except when the plants are very young, and then it should be done with great care, so as not to check their growth, for this might have the effect of

starting them prematurely into flower. Before taking up the plants, either for temporary or permanent plantations, the seed-beds ought to be well watered, moistening the soil to the full depth of the roots. The plants should be removed by loosening the soil when it is moist, yet not in a wet state. Each plant on removal should be examined, to see that it is not *blind*, that is, without a heart, central bud, or growing point; for it frequently happens, that after several leaves have been formed, the central bud is stopped and completely overgrown by the base of the uppermost petiole, so that no more heart-leaves nor any flower-heads can be formed. All that are found to be in this condition should, of course, be rejected, and likewise those which have any small knobs on the roots that would probably lead to clubbing.

Broccoli succeeds best in a good substantial, fresh, loamy soil. In such it may not grow so large as in that which is very rich and highly manured; but the quality is finer, and the plants are not so liable to be attacked by the maggot which causes the *club*, as in old richly manured garden soil. Where this disease is prevalent, the ground should be well trenched, taking care that the upper portion of the soil is turned to the bottom of the trenches. In this case, manure will generally be required. For autumn sorts, the ground may, in all cases, be highly manured; but if made too rich for winter and spring sorts, the plants will, in consequence, be succulent and tender, so that they will be more liable to be injured by frost than those not stimulated by manure. In many cases there is but little choice as regards situation; but where there is, it ought to be considered. It has been ascertained, that in the late severe winters, broccoli plants growing in the open fields have been nearly all saved; whilst those of the same sort planted in well-sheltered gardens, have been killed almost entirely.

With regard to manure, farm-yard manure is probably the best; but in some cases, other substances may be applied with advantage. In gardens that have been long cropped with vegetables, marl will be an excellent application for this crop. Lime may also be employed with advantage, as well as a manure as for killing insects. It may be mixed with the soil in digging, or applied occasionally, and when newly slaked, to the surface of the ground; but not after the heads begin to

form. Flowers of sulphur dusted on the roots at transplanting, will tend to prevent mildew; common salt and nitrate of soda may be used with advantage in killing worms or grubs which attack the stem and roots. Guano is a powerful stimulant; but it produces a rank growth; and though the produce may be large, the quality is not so fine as that obtained where marl is applied.

The distance at which any sort should be planted out, depends on whether it is a large growing sort or not, and also on the quality of the soil. Some of the largest sorts may be 3 feet between the rows, and the plants $2\frac{1}{2}$ feet apart in the row. Moderately large growers may be planted 2 feet asunder each way; and smaller sorts 2 feet between the rows, and 18 inches from plant to plant in the row. If the ground be too dry, it would be advisable to water it before planting. Where extensive tracts are cropped, as in some market gardens, this may not be practicable; but in private gardens, where water is generally at hand, there can be no great difficulty. It is not a good plan to pour some water at the side of the plant, leaving the surrounding ground still dry; for in this case the roots, pushing through the moist earth, soon find themselves in contact with dry soil, and thus their action and progress is, for want of moisture, suddenly checked. It would be well to render moist the whole of the soil as deep as the extremities of the roots; or if this cannot be done, shallow and rather broad drills should be drawn at the distances intended for the rows, and the whole extent of each watered through a wide-pierced rose. In this way the roots can extend unchecked among the moist soil in the direction of the rows, till rain fall and moisten the soil in all directions. After the drills have been thoroughly watered, planting should not be attempted till next day, or till such time as the soil will not puddle by working. When planted, a moderate and regular watering should be given, and nothing more will be required till the surface become dry, and then it should be stirred. If dry weather continue, occasional waterings may be required. The surface of the ground should be kept stirred, and some earth drawn to the stems. When the heads of white broccoli are exposed to light, and especially to the direct solar rays, the colour is soon changed to a dingy or yellowish hue. It is, therefore,

necessary to guard against this as much as possible, by frequently going over, and where any heads are not naturally hid, one of the adjoining side leaves should be bent over the flower-head, so as to shade it from the light, and likewise from rain. This can be done by half breaking the stalk of the leaf, or its midrib. Some kinds are almost self-protecting; whilst in others the leaves spread, and, consequently, more care is required in shading the heads of these sorts.

Protecting and Preserving Broccoli in Winter.—Although most of the varieties of broccoli are hardy enough to resist the cold of tolerably mild winters, and some kinds even withstand frosts that are rather severe, yet we occasionally experience winters that cut off nearly every kind. It is, therefore, advisable to adopt such means as will insure at least a portion of the crop. This can be done most effectually, by taking up, on the approach of frost, those which have either formed, or are just beginning to form a head, and placing them side by side on the floor of a cellar. They should be taken up on a dry day. The temperature of an underground cellar is usually between 45° and 50° , and this will be sufficient to push the plants into flower-heads, the substance for the growth of which is derived from the stem. In this way broccoli is secure from frost, but the flavour is not so fine as that of plants grown in the open air. Another mode of protection is to dig a trench at the end of a row, and then incline the plants one after the other, so that the soil may come close up to the bases of the lower leaves; or, a trench adapted to the size of a transplanter may be dug along the side of a row, and the plants taken up and dropped in, so that their necks may be a few inches above the level of the quarter. When thus transplanted, the soil should be drawn up and pressed close to the necks of the plants, thus forming a slight ridge to throw off the rain. Another mode consists in taking the plants carefully up with balls, and replanting them tolerably close together, with their heads inclined towards the north. All these transplantations should be done in October, or in the end of September, in the north, and whilst there is still heat enough in the ground to encourage fresh roots. Means may also be adopted for protecting the plants without removing them. To do this, in planting, mark off two rows 18 inches apart; then a space of 4 feet; and again other

two rows, 18 inches apart, and so on, having a 4-foot space between every pair of rows. The plants may be only 15 or 18 inches apart in the rows, according as the sort is large or small, and according to the richness of the soil. In these rows, winter and spring sorts should be planted; but along the middle of each 4-foot space, a row of early broccoli may be planted, such as will be cleared off before protection is required for the winter kind; or, till that time, it may be found convenient to occupy the space with some other crop. Before frost becomes severe, each pair of rows can be hooped over and protected by mats, straw covers, or any other protecting materials that can be easily removed, either partially or entirely, during the day, and replaced at night, according to the state of the weather. But now that glass is cheap, boxes could be made so as to include rows, and with sloping glazed lids that could be readily opened and shut, and a protection of this kind would doubtless prove cheaper in the long run than some other modes less effective, and requiring more labour.

Taking the Crop.—Broccoli, for some tables, is required to be cut when not larger than a tea-cup; for others it is allowed to be full-grown; but in no case should it be allowed to remain till the compactness of the head is broken. It should always be cut whilst the *curd*, as the flowering mass is termed, is entire, or before bristling leafy points make their appearance through it. In trimming the head, a portion of the stalk is left, and a few of the leaves immediately surrounding the head, their extremities being cut off a little below the top of the latter.

To save Seed.—Select those plants that in leaf and flower are most characteristic of the variety. Some allow them to remain where they have grown; others prefer transplanting them carefully, supplying them regularly with water during the summer. In selecting for seed, those plants which have a disposition to produce larger and coarser leaves than the other should be avoided, as they are most likely to produce a degenerate offspring. For early sorts, the smallest plants with the least undulated leaves may be selected and planted out late in the season, and afterwards removed and replanted in fresh soil, in order to retard their flowering till next spring.

Insects, &c.—See CABBAGE.

BRUSSELS SPROUTS (*Brassica oleracea bullata*

gemmifera, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.)—Although buds or their rudiments exist at the axils of all the leaves of the cabbage tribe, yet in many cases they do not push, especially in the first year of their growth. In the second year after sowing, it will be observed that the stems of the common borecole become covered with open leafy sprouts; but in the first season buds push all along the stems of Brussels sprouts from every point whence a leaf had proceeded. These buds, about the size of a walnut, are arranged spirally on the stem, which is often completely covered by them. They are firm like little cabbages, or rather like hearted Savoy in miniature. A small head, resembling an open Savoy, surmounts the stem, and maintains a circulation of sap to its extremity. Most of the original side leaves drop off as the buds enlarge. The stem sometimes attains the height of 4 feet; but dwarf stems produce sprouts more tender and succulent when cooked than those obtained from very tall stems. Brussels sprouts are, in fact, much allied to the Savoy, some of which, the Early Ulin Savoy, for instance, throw out sprouts from the axils of the leaves below the head, which are very similar to the Brussels sprouts, only larger and not so compact.

This vegetable has long been cultivated near Brussels, the place from which it derives its name. Dr. Van Mons, of Louvain, says: "We have no information as to the origin of this vegetable; but it has been a very old inhabitant of our gardens, for it is mentioned in the year 1213, in our regulations for holding the market, under the name of *Spruyten* (sprouts), which it bears to this day."—(*Horticultural Transactions*, vol. iii. p. 198.)

There are no varieties of Brussels sprouts distinguished by name; some plants grow taller than others; but in this there is little permanence of character. Seedlings vary in height, as they also do with respect to the sprouts being more or less compact. The plant is, however, very apt to degenerate, owing to what cause it is difficult to say. "Much has been said," remarks Dr. Van Mons, "of the disposition of this plant to degenerate. In the soil of Brussels it remains true, and I have lately observed it to do the same in Louvain; but at Malines, which is the same distance from Brussels as Louvain, and where the greatest attention is paid to the growth of vege-

tables, it deviates from its proper character after the first sowing; yet it does not seem that any particular soil or aspect is essential to the plant, for it grows equally well and true at Brussels, in the gardens of the town, where the soil is sandy and mixed with a black moist loam, as in the fields, where a compact white clay predominates." Having been long grown true at Brussels, and their degeneracy from seed saved elsewhere being so frequent, it has been supposed that from Brussels only could genuine seed be obtained; but Mr. Judd, of Althorp Gardens, Northampton, and Mr. Lauder, of Goshen, near Edinburgh, have proved that excellent sprouts, quite equal to those from seed obtained from Brussels, may be produced from seed saved year after year in this country. Mr. Judd has exhibited stems of Brussels sprouts raised from seed saved successively in this country for upwards of twenty years. These stems were more than 3 feet high, and studded throughout their length with close firm sprouts.

This vegetable was supposed to be too tender for our winters. It proves, however, to be more hardy than the Savoy, or almost as hardy as the borecole, and it is possessed of much greater excellence than either. When well grown, the amount of its edible produce is more than equal to that of the borecole. The cultivation of Brussels sprouts ought, therefore, to be more extensively adopted. In many parts of the country they are only to be found in the gardens of the rich; but they might be advantageously cultivated in those allotted even to cottagers.

With regard to soil, Brussels sprouts will grow in any garden soil or cultivated field. Mr. Judd, who, as above mentioned, produced them in perfection, states, that one part of the garden is rather light and sandy, upon a substratum of old red sandstone; that another part is a stiff heavy soil, upon a substratum of blue clay; but that this vegetable grows equally well on both of these soils. This statement as to Brussels sprouts succeeding well in soils very different in their nature, is corroborated by that of Dr. Van Mons, and by the observations of practical men.

In poor soils manure may be given; but its application in large quantities is not in any case advisable, for it stimulates the plants rapidly into great luxuriance, and thus tends to make them produce larger but not such compact sprouts.

Sowing.—For the principal winter crop, sow about the middle of March, and first or second week in April; and for a succession for late spring use, a small sowing should be made in the first or second week in May. For an early crop, sow, as they do at Brussels, in slight bottom heat in February, and plant out in a warm situation in April. In Scotland, and in cold situations in England, sow in August, and transplant the seedlings in spring; for succession, sow again in March, and a small sowing may be made in April. From late sown plants less produce is obtained than from those sown early, but the quality is more tender.

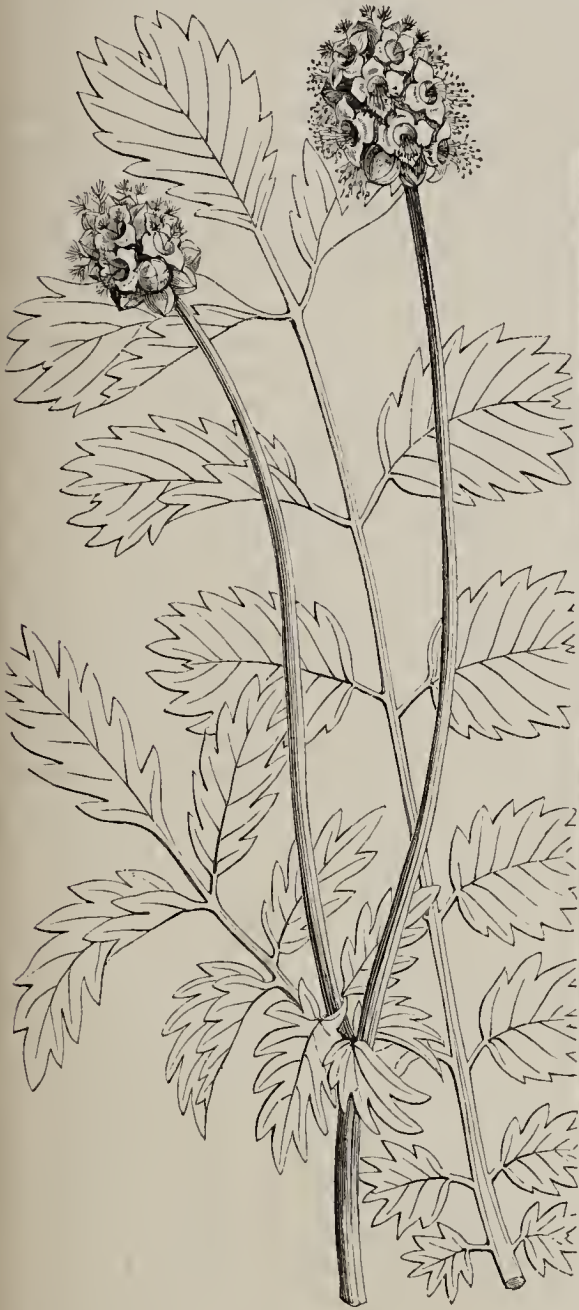
Planting.—In strong rich soils, where the plants grow tall, the main crop may be planted in rows 2 feet asunder, and the plants 18 inches apart in the rows. In general, 2 feet between the rows, and 15 inches from plant to plant in the rows, may be considered to be proper distances. The latest sowings may even be planted at 2 feet from row to row, and a foot apart in the rows. After planting, the usual routine of watering, stirring the soil, and keeping it clear of weeds, should be persevered in. A little earth may also be drawn to the stems, except when these are furnished with sprouts too low to admit of such being done. As the side leaves get old, or begin to fade, they should be gradually removed, commencing with the lowest. Some cut off the head entirely when the sprouts are formed, but this we do not recommend, for the leaves shelter the sprouts to a considerable extent from frost and snow. Besides, from the large wound exposed at the top of the stem, the latter is far more liable to be injured by frost than would otherwise be the case. The tops may, however, be cut off, as they do at Brussels; that is, about ten or fifteen days before it is intended to gather from the stems. The tops may also be used as greens. In spring, when the sprouts are disposed to run to seed, the plants should be taken up and planted in a shady place, to retard their growth.

BUCKSHORN PLANTAIN, or *Star of the Earth* (*Plantago Coronopus*, L.—Tetrandria Monogynia, L.; Plantagineæ, D. C.; Plantaginaceæ, Lind.) is a hardy annual, a native of Britain. It was formerly cultivated in this country for the leaves, which were gathered when tender, and used in salads: the French still continue to grow it for the same purpose. It prefers

a light soil, and is propagated by seeds, which should be sown thinly, broadcast, and raked in, in March. When the young plants are about an inch high they may be thinned out to about 4 inches apart.

BURNET (*Poterium Sanguisorba*, L., Fig. 154—*Monœcia Polyandria*, L.; *Rosacæ*, D. C.;

Fig. 154.



Sanguisorbaceæ, Lind.) is a hardy perennial, a native of Britain, where it is commonly found growing in chalky soils. The young and tender leaves, which taste and smell like cucumbers, are put into salads, soups, and cool tankards. It will grow in any soil, but succeeds best on a light dry one. Sow in

March and April, or in autumn, when the seeds ripen, in drills 8 inches apart, and thin out, when the plants are 2 or 3 inches high, to 6 inches asunder in the row. Or propagate by parting the roots in February, planting the divisions in rows at the above distances. All the culture necessary is to hoe the ground occasionally, to water in dry weather, and to cut off the flower-stems when seed is not to be saved.

CABBAGE (*Brassica oleracea capitata*, D. C. — *Tetradynamia Siliquosa*, L.; *Crucifere*, D. C.; *Brassicaceæ*, Lind.) is a hardy biennial, derived from the *Brassica oleracea*, which is found wild in Yorkshire, near Dover, in Cornwall, and in Wales. It is also found wild on the coasts of France, and of many other countries of Europe. De Candolle, in his excellent memoir on the different species of the genus *Brassica*, in the fifth volume of the *Transactions of the Horticultural Society*, states, that this race of cabbages was known to the ancient Gauls by the name of *Chou capu*; the Italians call it *Capuccia*; both names derived from *caput*, a head: whence has proceeded that of *Chou cabus*, and doubtless from the latter the name of cabbage has arisen.

The principal sorts of cabbage are :—

1. **EARLY BATTERSEA**—syn. Dwarf Battersea, Early Dwarf Battersea, Vanack, Early Vanack, Early Russian, Cock's Best Cabbage, Early Imperial, Fulham, Early Fulham.—The type of the Early Battersea is very old. About the year 1776 some cabbage plants were received without a name, from near London, by Mr. Torbron, gardener to the Earl of Egremont, at Petworth. He considered it to be the same sort as one he had previously known, called the Vanack; and he continued to cultivate it under this name for upwards of fifty years. Latterly it has been found to correspond with Cock's Best Cabbage, which, I am informed by Mr. Cock, is the Early Dwarf Battersea, carefully saved and kept true. It has been grown in his grounds for upwards of fifty years. When fully grown, the four outside or lower leaves are about 16 inches in diameter—when taken off and spread out their general outline is nearly circular. The stem is very dwarf, and the leaf-stalks come out quite close to each other; so that scarcely any portion of the stem is to be seen between them. The whole cabbage measures about 3 feet in circumfer-

ence. The heart is shortly conical, with a broad base, near which it is about 26 inches in circumference, after the outside leaves are taken off, so as to leave only what is fit for use. The ribs boil tender. It is the best sort for the general crop of early cabbages, is not liable to crack, and if cut close to the base, four nice cabbages may be obtained in the course of the summer from each stem; thus affording a supply till the ground requires to be cleared for other crops. Nearly allied to the Early Battersea are Sutton's Imperial, Early Sugar-loaf, Imperial Sugar-loaf, Early Wellington, Early Emperor, Early Nonpareil, London Market, Enfield Market, King of the Cabbages, Cattell's Reliance, Cattell's Superior Early, Cattell's Dwarf Barnes, Barnes' New Seedling, Norris' Superb Dwarf, Hâtif or Pain de Sucre.

2. COCK'S HARDY GREEN.—This is somewhat different from the Early Battersea, and answers well for coleworts. It is sown for that purpose about the third week in June. It is hardy, and though sown early, is not apt to run to seed.

3. EARLY YORK—syn. Early Dwarf York.—An old and much esteemed sort, very generally cultivated for the earliest crop. The stem is short, head small, oval, leaves dark green, fleshy, ribs less prominent than in any other variety. Atkin's Matchless, Early Hope, Tiley's Early Marrow, and Sutton's Dwarf Combe, are very good dwarf early varieties, allied to the above.

4. EARLY CORNISH—syn. Cornish Paington, Penton.—This sort is cultivated in Cornwall, Devonshire, and other parts of the west of England, where the mildness of the climate suits its rather tender habit. It has long tall leaves, of a pale and somewhat yellowish green, forming a heart, but not a compact one. When boiled it is tender, and somewhat resembles the Dwarf Portugal cabbage, but not so good, neither is it equal in quality and earliness to such sorts as the Early Battersea, and others mentioned above.

5. POMERANIAN CABBAGE—syn. Chou conique de Poméranie.—A hardy sort, tall, with a remarkably sharp-pointed, long, tapering, conical head, which becomes very firm. On the Continent the plants are taken up when full grown, and laid sloping towards the south, nearly close together, and so deep as to admit of the soil being brought close to the neck of the cabbage. Sow in March for summer use,

and in May for winter. It requires to be planted 2 feet apart every way.

6. WINNIGSTADT CABBAGE—syn. Chou pointu de Winnigstadt.—Stem dwarf, head large, broad at the base, sharply conical, heart compact, boiling tender. The leaves, till blanched by hearting, are of a glaucous hue, like those of the cauliflower or broccoli. A good late cabbage. Sow in March for summer use, and in May for autumn and winter supply.

7. LARGE DRUMHEAD—syn. Drumhead Field Cabbage, Scotch, Large Scotch, Flat-pole, Strasburg.—Of this there are some sorts differing in the length of stem, and also in the head being round, or more or less flat. This cabbage is well known, but is seldom required in gardens.

8. JOANNET CABBAGE—syn. Chou Joannet.—A very good early flat-headed sort, very firm, and remarkably dwarf. It may be planted a foot by 15 inches apart; and, consequently, it is well adapted for small gardens.

9. VAUGIRARD CABBAGE—syn. Chou de Vaugirard, Chou pommé d'hiver.—A large, very late, but rather coarse French variety. The head is generally round, leaves deep green, the outside ones having the veins sometimes tinged with red. If sown in June, and planted out in the beginning of August, it will come in for use in February, March, and April; and thus fill up the void which sometimes occurs when other cabbages are exhausted, and before the early crops come in. On this account, a little of it may be sometimes cultivated with advantage.

10. PORTUGAL CABBAGE—syn. Large-ribbed Cabbage, Braganza Cabbage, Couve Tronchuda, Chou à grosses côtes blondes.—This is much cultivated at Braganza, in the province of Tras-os-Montes, and in other parts of the north of Portugal. It was introduced into this country in 1821. It grows fully 2 feet high; the mid-rib is very thick, nearly white, and branching into veins of the same colour. Divested of the green part, and well boiled, the ribs make a dish resembling sea-kale.

11. DWARF PORTUGAL CABBAGE—syn. Dwarf Couve Tronchuda, Murciana.—This is a dwarf sort, earlier than the preceding, with a roundish, tolerably compact head. It is exceedingly tender when boiled, and of much finer quality than the other, to which it is to be preferred when the heart is to be cooked in the usual

way. Not being adapted for withstanding severe winters, it should not be depended on except for summer and autumn crops.

The *White-ribbed Avilès Cabbage* (Chou à côtes blanches d'Avilès), described by Professor Morren in the *Journal d'Horticulture de Gand* for January, 1848, appears to be closely allied to the Dwarf Portugal, if not identical with it. It has white ribs, and forms a close heart. Professor Lesoinne, of Liege, who introduced it into Belgium from the vicinity of Avilès, on the coast of the Bay of Biscay, gives the following mode of cooking this cabbage:—It is first boiled whole; slices of soaked bread are then laid in the bottom of a baking dish; next a layer of the boiled cabbage; over this some Parmesan cheese, well dried and grated, or high-flavoured Dutch may be substituted; other layers of soaked bread, cabbage, and cheese, are put in till the dish is full, taking care to finish with the cheese. The whole seasoned with salt, pepper, and other aromatics, is sprinkled with boiling water, and then put into the oven till it acquire the requisite degree of tenderness: it is served up hot.

RED CABBAGE (*Brassica oleracea capitata rubra*, D. C.)—Of this there are several varieties, differing in size and depth of colour. The principal are:—

12. **RED DUTCH**—syn. Drumhead, Large Red, Large Blood-red.—Head large, round, or flattened; the sort chiefly grown in market gardens.

13. **DWARF RED**.—This has a small firm head, of finer quality than that of the preceding.

14. **UTRECHT RED**—syn. Chou noirâtre d'Utrecht.—A small but very fine dark red cabbage. It may be sown in the first week of April and in the end of July.

15. **SUPERFINE BLACK**.—Small like the preceding, but of a still darker red. When pickled, however, the dark colouring matter is greatly discharged, so that the substance is left paler than that of others originally not so dark. It is therefore not so good for pickling as other sorts which retain their colour and brightness.

Soil.—A very rich soil, plentifully manured, is essential for the production of tender and succulent cabbages. Near London this vegetable is grown in perfection, in ground that is of a good substantial nature, and likewise in that which has become light by the application

of enormous quantities of dung, during a long period of years. The ground, however, is trenched, or undergoes *double digging*; that is to say, it is dug two spades' depth. By so doing, the lower portion is turned up to the action of the weather, and substances in the soil previously inert, are thus subjected to a fresh decomposing action, which renders them available for the nourishment of the plants. On the other hand, by turning down the top soil to the above depth, the eggs and larvæ of many insects are destroyed; hence, in ground so managed, the plants are not so liable to be attacked by the club, as in ground that is merely dug over. Cabbages will grow on soil that is too adhesive for turnips, but the manure applied to such a soil should be of an opening nature, and all the better if not much decomposed. Stable dung, or farm-yard manure, in a fresh state, will be most proper in this case, and it should be buried to the depth of one spit below the surface. They also grow well on peat soil; but to such, a dressing of lime, marl, gypsum, or even burned clay, will be advantageous. Guano, superphosphate of lime, lime rubbish, wood ashes, and marl, have been applied with advantage; and other artificial manures may be given occasionally; yet they have not the mechanical advantages possessed by farm-yard manure, for the latter, by keeping the soil open, acts as a kind of drainage, in consequence of which the plants are enabled to grow better during wet weather, in winter and spring, than would be the case if the ground were saturated with moisture.

The following analysis of the ash of the leaves of the cabbage, shows the inorganic substances withdrawn from the soil by this vegetable, and may assist in determining the nature of the manure required for the crop. The leaves, in an undried state, contain from 0·8 to 1·5 per cent. of ash, which, according to Fromberg, consists of—

Potash,	11·70
Soda,	20·42
Lime,	20·97
Magnesia,	5·94
Oxide of iron,	6·60
Phosphoric acid,	12·37
Sulphuric acid,	21·48
Chlorine,	5·77
Silica,	0·75
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	100·00

From the above it will be seen that lime, soda, and sulphuric acid, occurring in nearly

equal amounts, form the principal inorganic constituents of the plant; whilst the proportion of potash is small compared to that contained in most other vegetables.

Sowings.—The first sowing should be made about the end of February or beginning of March. It should chiefly consist of the Early Battersea. A few, however, of the Early York, or allied kinds, may likewise be sown at the same time. From this sowing, a supply will be obtained for use in July and August, and will thus form a succession to the autumn-sown crops.

A second sowing, which may be considered the principal spring one, consisting chiefly of the Early Battersea and similar kinds, should be made in the last week of March, or first week in April. This will come in for use from August till November.

A third sowing, to consist chiefly of the Early York, Atkin's Matchless, or similar kinds that heart quickly, may be made in May for young-hearted cabbages in the early part of winter, or to be used as coleworts, if severe weather prevent their hearting.

The fourth, or autumn sowing, as it is occasionally termed, is the most important, as it furnishes the plants which afford the principal supply of cabbages for spring and early summer use. The proper time for this sowing cannot be precisely stated. It varies from the middle of July to the middle of August, according to the soil, climate, and variety employed; a cold soil and climate requiring the earlier period, whilst the later period is the most suitable where the contrary is the case. The Early Battersea and allied sorts not being apt to run to seed, may be sown earlier than the Early York, and others similar to it, which often start into flower without previously forming a heart. In warm soils and situations, it is found, from long experience, that the best time for sowing such kinds as the Early Battersea, is about the 25th of July. Many of the market gardeners near London always sow on that day, if circumstances will permit, and if not, as soon afterwards as possible. In cold situations, and generally in Scotland, the last-mentioned sort should be sown ten days or a fortnight earlier, or from the 10th to the 15th of July. The Early York, and others of a similar nature, would run to seed if sown in July; such kinds, therefore, ought not to be sown till the second week of August in the north, and not till the end of that month in

the warm parts of the south. Those sown in July will be ready to plant out in the beginning of September; and those sown in August, in the end of September, or beginning of October, when ground, occupied by pease, beans, &c., can be cleared for their reception.

Red cabbages should be sown in the end of July and in March; and a few of some small sort may be sown in a frame in the end of January, or beginning of February, as they may be wanted for pickling before those sown in March are fit.

Sowing for Coleworts.—The cultivation of an open, hardy Dorsetshire kale, as winter greens, has long been discontinued. These greens were known under the name of coleworts. This name, or others evidently derived from it, as *collard* and *collet*, is now applied to young unhearted cabbages, which are pulled up by the roots, and tied in bunches for the market. The Early Battersea answers well for this purpose, and a sort allied to it, called Cock's Hardy Green, still better. These kinds are sown for coleworts about the third week in June. Atkin's Matchless may be sown about the middle of July; and successional plantations, for filling up spare ground, may be made from the principal autumn sowing of cabbages in July.

The sowings made at the above-mentioned periods will generally be sufficient for a supply throughout the year; but in case of any deficiency in the autumn-sown crop, it will be advisable to sow some of the early kinds, and also a few small red cabbages, on a warm border, about the end of January, or beginning of February; or, preferably, in a frame, taking care, however, that the plants are kept thin, exposed as much as possible to the light, plenty of air being given at all times, and covering only when the severity of the weather renders it absolutely necessary.

Mode of Sowing and Cultivation.—The soil for the seed-beds should be rather light, moderately rich, and well pulverized. On a large scale, the ground is raked tolerably smooth, sown broad-cast, raked, and rolled. Or, after sowing, 1-foot alleys are marked off, so as to leave 4-foot beds; a slight covering of soil from the alleys is scattered over these, and the beds are then raked and rolled. In private gardens, where extensive sowings are not required, they can be made with greater care. After the beds are prepared for sowing, it is a good plan to lay a rod across the bed, and then press

it down, and draw it a little backwards and forwards, so as to make a shallow groove, making others about 4 inches apart, in the same way. Sow in these, cover thinly with fine soil, and then finish by passing a light roller over the bed, or by beating it lightly with the back of the spade. After sowing, water; and if the weather is very hot and dry, cover with a mat, in order to keep the surface moist till the plants begin to make their appearance. Being in rows, the plants can be easily and regularly thinned, and the spaces between them should be kept stirred with a small hoe. By these means, healthy plants will be reared, and not being allowed to become crowded, their foliage will be enabled to form good roots, without pricking out into nursery beds, as is sometimes done in order to encourage the production of more fibres. This object may also be effected by thoroughly watering the beds, about a week before transplanting, and then raising up a little both soil and plants with a fork. In consequence of this moving, fresh roots are emitted, and the plants suffer less when they come to be finally transplanted.

The distances at which different sorts require to be planted, depend on the size which they usually attain, and on the richness of the soil. The smallest sorts may be planted a foot apart each way; the Early York, and others of a like size, may be 12 inches apart in the rows, and 15 inches from row to row; but a somewhat greater distance may be allowed in very rich soil. Near London, the Early Battersea is planted for spring cabbages, at 2 feet apart each way; but then the rows are *backed*, as it is termed, with plants, sown a week or ten days earlier. A plant is inserted between every two in the rows already planted, to be afterwards drawn as coleworts; and, for the same purpose, an intermediate row is planted a foot apart in the intermediate space. The ground is then occupied with plants at a foot apart each way, but all are removed for use as coleworts in the course of the winter, except those planted at 2 feet apart for hearting in spring. If coleworts are not to be grown intermediately, the distance between the plants is reduced to 22 inches each way.

In soil that is not very rich, the Early Battersea, and similar sorts, may be planted at 20, or even 18 inches apart each way. The large sorts of red cabbage should have $2\frac{1}{2}$ feet between the rows, and 2 feet between the plants in the row; the Large Drumhead, 2

feet apart in the row, and 3 feet between the rows.

The ground having been well prepared, and the distances for the rows accurately marked off on both sides, the line is stretched and pressed by stepping upon it all along, so that its mark may be left on the surface. All the rows having been thus marked in one direction, say lengthwise, they are then marked across in a similar way, and the plants are inserted exactly at the intersection of the lines. It may here be observed, that great care is often taken to plant in line both lengthwise and across, notwithstanding which, the planter is surprised by the crooked unsightly appearance which his work exhibits in every point of view except those above-mentioned. In general this is solely to be attributed to inaccuracy in measuring the distances from line to line, for if these are not equal, although they may run straight both lengthwise and across, yet the plantation will show crooked lines diagonally. If it be intended that the lines should be one way 24 inches apart, all lines in that direction should be exactly 24 inches apart; and whatever distance between the transverse lines may be determined on, it should be equally carried out, and then regularity will be apparent in all directions, or from every point of view.

Coleworts, as previously mentioned, are frequently planted between plants intended to remain for hearting; in which case, the distances between the rows of the latter may be said to determine the distance between the coleworts. These, when planted by themselves, may be about 7 or 8 inches apart, in rows a foot asunder, and every alternate plant in the row should be taken as required for use; the additional space thus given will soon be occupied by the remaining plants.

In planting out cabbages, advantage should be taken, if possible, of cloudy moist weather; but in long-continued drought the plants in the seed-beds may get so large, as to render it absolutely necessary to plant them out at all hazards. The surface of the ground for the intended plantation should be well pulverized, and drills, similar to those made for pease, should be drawn for the rows, and well watered a day previous to planting. If there are dry clods and dust on the surface, the consequence is this—when the dibber is thrust in and withdrawn, a portion of the dry clods and dust falls into the hole, and with this the

roots of the plants are placed in contact—a condition very unfavourable for their striking root. The seed-beds should also be well soaked, in order that the plants may be moved with little injury to the roots, which should be raised with a fork, and exposed to the air as little as possible. The plants should be planted towards night, as in that case they can be immediately watered without their sustaining injury from the sun's rays. The drills in which the cabbages have been planted should be kept only moist, and not what would be termed wet, till the plants have struck root, when, if the surface of the ground be kept stirred, watering will scarcely be required. Except in dry weather, furrows or drills for the plants are not required. Grounds which supply the best cabbages for the London market are planted on the level, and no mould is drawn to the stems, which, in fact, do not require it; for the best growers do not cultivate what are termed *long-legged sorts*, neither do they force their plants to become such by bad treatment, such as overcrowding in the seed-bed. These cultivators find it advantageous to stir the whole surface of the soil, and close to the roots of the plants; this they prefer to forming a ridge, which prevents the beneficial stirring of the soil near the plants, and affords a secure lurking-place for slugs and other enemies to the crop.

Propagation by Cuttings.—Cabbages are best raised from seed; nevertheless they may be advantageously propagated by cuttings in some cases—for instance, in warm climates, where it is difficult to save seed; and in this country it might be adopted in order to preserve any particular variety true: for by cuttings we can always depend on perpetuating the identical sort, but by seed this is uncertain. Supposing that it were desirable to preserve some much prized sort, seed may be saved, and cuttings struck as well. If plants from seed come true, so much the better; but if they do not, having the plants from cuttings, we are still in possession of the true variety, and of the means of again raising seeds from it. The mode of propagating by cuttings is very simple. The sprouts are taken off, and exposed to the air till their juices are so far exhausted as not to exude from the wounded ends, and thus tend to rot the cuttings. It is also advisable to dip the cut end in newly slaked lime, dry wood ashes, or powdered charcoal. The cuttings may then be planted out, either in the

open ground, or, better, in a frame, where they can be properly shaded, not from diffused light, but from the sun's rays, till roots are formed. They may then be fully exposed till fit for planting out.

To save Seed.—The finest specimens should be selected for this purpose, and the more of them there are, the greater will be the chance of the sort being saved true. The plants may either be allowed to run to seed where they have grown, or they may be taken up early in spring, and planted up to the neck in some place where they can be protected from birds when the seed is ripening.

Insects and Diseases.—The cabbage, broccoli, cauliflower, and Savoy are attacked by numerous insect enemies. The leaves are devoured by the caterpillars of *Pontia brassicæ*, *P. napi*, and *P. rapæ*, all of which are very abundant and destructive. The caterpillars of the cabbage-moth (*Mamestra brassicæ*) do great mischief by eating the hearts of cabbages and cauliflowers, rendering them totally unfit for use; nor do they refuse the leaves of any of the cabbage tribe. Hand-picking and dusting the plants with newly slaked lime are the only means known by which these destructive insects can be kept in check. Another insect injurious to the leaves, and especially so to those of cabbage and broccoli, is a minute fly, called *Aleyrodes proletella*. It is very abundant from midsummer to the end of autumn, and from going through all its changes in less than a month, its numbers increase with alarming rapidity. Cutting off and burning the infected leaves is the only way of arresting its progress. Besides the above, the cabbage-leaf plant-louse (*Aphis brassicæ*) proves very injurious to cabbages, and particularly so to broccoli and Savoys; the blue cabbage-flea (*Altica consobrina*) perforates the leaves, which are also much injured by the caterpillars of the garden pebble-moth (*Scopula forficalis*). The maggots of *Anthomyia brassicæ* do great mischief by eating passages in the roots and base of the stem, causing these parts to rot, in consequence; and the caterpillars of the heart and dart-moth (*Agrotis exclamationis*), of the common dart-moth (*A. segetum*), as well as those of the great yellow under-wing moth (*Triphaena pronuba*), rapidly destroy the plants by eating through the tap-roots at a little below the surface. Hand-picking is the best means of diminishing the numbers of these destruc-

tive grubs. The larvæ of the crane-fly (*Tipula oleracea*) likewise attack the roots, in which also the snake millipedes are sometimes found in great numbers. Snails and slugs attack all the cabbage tribe, and frequently prove very destructive: the best mode of destroying them consists in dusting the plants and the ground about them with newly-slaked lime.

Small excrescences are frequently seen in winter and spring, near the surface of the ground, on the roots and stems of cabbages. These are caused by the deposition of the eggs of a small weevil (*Ceutorhynchus sulciollis* Gyllenhal *Curculio pleurostigma*, Marsham), the larvæ of which are hatched and attain their full growth in the galls.

The formation of protuberances on the roots, usually termed *clubbing*, is the most destructive disease to which the cabbage tribe is subject. It is ascribed to one or more species of insects, maggots being generally found in the tubercles. Lime, wood ashes, soot, nitrate of soda, and common salt, are considered to be useful applications to the soil in which cabbages, &c., are to be grown, and marl unquestionably is so. It is also a good plan to dip the roots of plants about to be planted in a mixture of soot and water made of the consistency of thick paint; to this some recommend the addition of saltpetre, in the proportion of 1 lb. to every gallon of soot. The seed-beds should be frequently inspected, and if any symptoms of clubbing are discovered, the plants should be immediately transplanted into nursery beds of a different kind of soil from that of the seed-beds. In transplanting, all plants in any way clubbed should be thrown away, or, if this cannot be afforded, the tubercles should be cut off with a sharp knife.

Cabbages are also attacked by various species of fungi, for which the best known remedy is sulphur, which is more especially efficacious when applied at the earliest stage of the attack. It cannot, however, be adopted on a large scale after planting out, but it can be very advantageously applied to the plants in the seed-bed, and at little expense. Applied early, sulphur acts as a preventive, and that prevention is better than cure can in no case be said more truly than in that of the mildew.

CAPSICUM. See FORCING.

CARAWAY (*Carum Carui*, L., Fig. 155—*Pentandria Digynia*, L.; *Umbelliferae*, D.C.;

Apiaceæ, Lind.) is a biennial plant, a native of the Continent, though it is said to be found wild in this country.

Fig. 155.



The seed is much used in confectionery, and for flavouring spirits and perfuming soap; it yields an oil, which is employed medicinally as a carminative. Considerable quantities are grown in Essex and Kent for these purposes.

Sow in drills, 10 inches apart, in autumn, when the seed is ripe, or in March or April. When the plants are 2 or 3 inches high, they should be thinned out to 8 inches apart, and

the ground must afterwards be kept free from weeds, and stirred by an occasional hoeing. The seed will ripen in the following year, in July or August.

CARDOON (*Cynara Cardunculus*, L.—Synonymesia Polygamia *Æqualis*, L.; Compositæ, D. C.; Asteraceæ, Lind.)—The cardoon is a perennial plant, a native of Candia and Barbary. The stalks of the leaves, or ribs, as they are usually termed, are blanched, and, when properly cooked, constitute a tender and excellent vegetable, much esteemed on the Continent, but seldom used in this country, except by French cooks. The flowers, like those of the artichoke, have the property of curdling milk. The varieties are:—

1. COMMON CARDOON.
Cardon plein inerne.
Cardon plein et sans épines.
2. SPANISH CARDOON.
Cardon d'Espagne.
3. TOURS CARDOON.
Cardon piquant.
Cardon de Tours.
4. RED-STEMMED CARDOON.
Cardon à côtes rouges.
5. PUVIS CARDOON.
Cardon Puviss.

The common cardoon has spineless leaves, leaf-stalks solid, but not so thick nor so tender when cooked as those of the other varieties; the plant is also apt to run to seed. The Spanish cardoon has spineless leaves, large ribs nearly solid. Like the preceding, it is apt to run to seed. The leaves of the Tours cardoon are excessively spiny, so much so, that great care is requisite in working among the plants, for the spines are long and very sharp. Notwithstanding this drawback, the variety is much cultivated in France on account of its large, thick, solid, tender ribs. The plants are not so liable to run to seed as those of the preceding varieties. The red-stemmed cardoon is an excellent variety recently obtained from Marseilles. Leaves nearly smooth; ribs tinged with red, very large and solid, not apt to run to seed; but scarcely so hardy as the Tours cardoon. The Puviss cardoon is remarkable for its strong growth, the large size it attains, and the thickness of its ribs, which are almost solid. The leaves are thick, not at all prickly, or only very slightly so. It is a fine variety, of more tender substance than the Cardoon de Tours.

This plant prefers a light, warm, moderately rich soil, and an open situation. All the sorts

are raised from seed, which may either be sown where the plants are to remain, or in pots under a frame for transplanting. A small quantity to come in early, may be sown on a slight hot-bed about the end of March; but the main crop should not, in general, be sown till the middle of April; and where the climate is warm, it is advisable to defer sowing it till the end of the month. A late crop for a succession may also be sown in the end of June.

Previous to sowing, trenches, 1 foot deep, 18 inches wide, and not less than 4 feet apart from centre to centre, should be prepared. In the bottoms of these, from 6 to 9 inches of well-decomposed dung should be dug in; the seeds may then be sown in the centre of the trench, in patches of three or four, and covered with earth to the depth of about 1 inch. The distance between the patches may be 18 inches. When the plants are 2 or 3 inches high, they should be thinned out, only the strongest plant in each patch being allowed to remain.

The after-management of the cardoon will be learned from the following account of the treatment adopted by Mr. Fleming, of Trent-ham:—"I choose for the cardoon," says Mr. Fleming, "a piece of ground that requires well pulverizing, and a rest from heavy cropping; as for growing them on the plan I follow, it matters not how poor or stiff the soil, so that the bottom be dry. The exposure must be an open one, as they will require a free circulation of air, and all the sun possible. Having marked off the spaces for the trenches and ridges, allowing 6 feet for each, those spaces marked out for the ridges are manured well and dug; for I keep in view the improving of the pieces of ground for other crops, as well as providing for the cardoon. The trenches are next dug out 1 foot deep, laying the soil right and left on the ridges, and breaking the lumps well as the work proceeds. The sides of the ridges should be well sloped off and beaten smooth with the back of the spade. The trenches being now ready, we wheel into them, to the depth of 4 to 6 inches, a previously prepared compost, consisting of chopped turfy soil, good solid half-rotted manure, and road-drift or fine ashes, and, if we have it, some burned clay, in about the proportion of equal parts of each kind. This is forked into the trench in such a manner as to keep the compost merely covered, while the ground

below is loosened to the depth of 1 foot at least, and this finishes the trench, which ought to lie uncropped until the season for planting out the cardoons, by which time the ground will be in fine order to receive them.

"We sow two rows of dwarf pease upon the ridges, and a row of spinach between; these will be off before the cardoons require earthing up. In the first week in May we sow the seeds in thumb pots, placing two sound seeds at opposite sides of the pot, and plunge the pots in a cold frame, which is kept close until the plants appear, when plenty of air is admitted to prevent them drawing up weakly. In a fortnight after the plants are up, they will be strong enough to plant out in this order: one row up the centre of each trench, 18 inches apart, and a row 2 feet from it in quincunx fashion on each side.

"Planting two plants together is to guard against losses by insects, and when all danger from this is over, the weakest can be destroyed. Raising them in pots, instead of sowing them in the ground, is to prevent gaps in the rows, and to give the opportunity of having all the plants in the ridge of equal size, so that when earthed up, the plants being alike in strength, the same quantity of soil will be required for all. The weakest plants may be kept in the cold frame ten days longer, which, with a second sowing, will give a succession. Water the newly turned out plants, and loosen up the soil between them, which finishes the planting part of the business. If dry weather succeed this operation, the plants will require watering once or twice, until they get established, after which they will only require to be kept clear of weeds till October. This will be most advantageously done by forking among them occasionally, which will keep the weeds in check, and promote the growth of the plants better than the use of the hoe. In the beginning of October, the most forward trench of plants will have attained their full growth, and a sufficient number of well twisted hay-bands must be provided for winding round them. Take advantage of a fine dry day, and commence by carefully bringing all the leaves into an upright position, in which they should be held by one person while another fastens the hay-band round the bottom of the plant, and winds away tightly until the whole of the stalk is bound round, and the end of the rope secured. Proceed in this way until the trench is completed, and then earth up till

the bands are covered with the soil, which should be pressed very tightly round the plant at the top, to exclude air and moisture as effectually as possible. Proceed in the same manner with the remaining trenches when fit, until the whole are finished. We have tried blanching by fastening the leaves closely together with string or matting, and putting an earthen drain-pipe over the plants, and filling up with sand. This plan answered admirably; the whole of the leaf-stalks were perfectly blanched, quite crisp, and fit for use. The adoption of this plan would prevent the loss of room occupied by the ridges, as no soil would be wanted for earthing; but it takes a pipe 7 or 8 inches in diameter for a well-grown plant, and these, if many are required, are expensive.

"The cook here, who is one of the first in his profession, gives me the following recipe for cooking and serving:—

"'After the cardoons have been trimmed and washed, and their outside leaves removed, cut them into pieces about 4 inches long. Put the pieces into a pan of cold water; when boiled, take them out, and with a cloth rub the outer skin until it can be easily removed. After this is done, let them be well washed and boiled in good stock or broth. Serve them very hot with brown sauce made with good gravy. It is an improvement in serving the cardoon to put some marrow round it if you have any.'"—(*Gardeners' Chronicle*, 1849, p. 20).

The cardoons will be fit for use in about three weeks after tying up. At the approach of severe frost it is advisable to protect the plants with litter. In France, before severe frost sets in, the plants having been tied up for about a fortnight, are taken up with balls in a dry day, and replanted close together in a cellar, where the process of blanching is completed. Kept in this way they are said to remain good till March. Those who have no room to spare, open, in a piece of dry ground, a trench 4 feet wide and 3 feet deep. They line the sides with a good thickness of straw, against which one or two rows of cardoons are placed, the extremities of the leaves being left above ground. They then introduce another layer of straw, and another row of plants, and so on till the trench is filled. The plants are next sheltered completely from rain, and protected from frost by long litter, which is always removed in mild weather.

Seed may be saved by planting some seedlings expressly for the purpose, or by allowing some plants to remain unblanched; in either case they must be protected from frost during the winter. The seed ripens in September, and will keep for five or six years, and even longer. The same plants will yield seed for several years in succession.

CARROT, The, (*Daucus Carota*, L.—*Pentandria Digynia*, L.; *Umbelliferae*, D. C.; *Apiaceae*, Lind.) is a hardy biennial, a native of Britain, where it is found wild very commonly by road-sides and on dry banks. The roots of the wild carrot are small, hard, and frequently much forked; but that it is the parent of our cultivated varieties has been proved by M. Vilmorin, who, by sowing late, and saving seed from selected plants, succeeded in obtaining, in three generations, roots of considerable size. M. Vilmorin (*Bon Jardinier*) states that some of the roots so obtained, were as large as garden carrots of the largest size, and their appearance was exactly the same; the flesh, however, was more compact and the flavour milder. By most of the persons who tasted them, they were considered to be superior to our old varieties.

The principal varieties of carrot cultivated in gardens are:—

1. **EARLY RED HORN**—syn. Early Scarlet Horn, Early Short Red, Carotte rouge court hâtive.—Leaves few and dwarf; root short, nearly cylindrical, terminating abruptly, with a slender tap-root. Flesh orange-red, heart reddish-yellow when young, becoming pale yellow when older. This is the earliest sort of carrot, and the one best adapted for forcing.

2. **COMMON EARLY HORN**—syn. Dutch Carrot, Dutch Horn.—Larger than the preceding, as regards both top and root; the latter tapers slightly, yet ends abruptly, and is terminated with a long fibrous tap-root. Flesh reddish, heart yellow.

3. **LONG HORN**—syn. Long Red Horn, Long Red Dutch, James' Orange.—Leaves few, moderately long, and slender. Root long, cylindrical, ending abruptly, like all the horn carrots; surface rather uneven and wrinkled. Flesh reddish orange, tender, very juicy, and of excellent flavour; heart small and nearly of the same colour as the flesh. An excellent sort for summer use.

4. **LONG RED**—syn. Surrey, Long Surrey, Long Red Surrey, Chertsey, Studley, Carotte rouge longue.—Leaves of moderate length;

roots long, tapering regularly to their extremity. Flesh reddish, heart yellow. This and the Altringham are the best two for the general crop.

5. **ALTRINCHAM**—syn. Altringham, Scarlet Altringham, Green-topped Superb.—Leaves long; root large, tapering slightly, but ending rather abruptly in a small tap-root; the surface is rather uneven and wrinkled. Flesh bright reddish orange, very sweet and crisp, like that of the horn carrots; heart small, dark yellow. One of the very best sorts for garden culture. It derives its name from a place called Altringham, in Cheshire, where it is supposed to have originated. In seedsmen's lists it is frequently but erroneously called the Altringham.

6. **LONG ORANGE**—syn. Sandwich, Carotte rouge pâle de Flandres.—Leaves long; root thick at the shoulder, thence tapering regularly to its extremity. Flesh orange; heart pale yellow. This sort was formerly more generally cultivated than any of the others, and it is still much grown; but its quality is inferior to that of the Long Red.

7. **WHITE BELGIAN**—syn. Green-topped White Carrot, Carotte blanche à collet vert.—This is the largest and most vigorous sort known, and will succeed in soils too strong for the finer varieties. It is better adapted for the field than for gardens; some of it may, however, be advantageously grown in cottage gardens. The leaves are strong and tall; roots very thick, a considerable portion rising above the surface of the ground acquiring a greenish tinge in consequence of exposure to the light. It cooks tender, but its colour is objectionable.

8. **PURPLE CARROT**—syn. Carotte violette.—Leaves tall, dark green; root of medium size, thick at the top, whence it tapers quickly. Flesh deep purple next the outside, light yellow near the heart; the latter is dark yellow, but sometimes the very centre is pale yellow. It is very sweet, but not fine flavoured, and its appearance is not generally liked. It is apt to run to seed in the first season of its growth, and therefore requires to be sown later than other kinds.

There are some other varieties named in seed-lists, &c., but the above comprise the principal sorts in cultivation, to one or other of which, new varieties, or those reputed as such, can be referred as identical, or nearly allied, as the case may be.

Soil.—A deep sandy loam is best for carrots; sandy alluvial soil, properly drained, will suit them, and heavy crops have been obtained on some peat soils. It is essential that the soil should be of a soft pervious nature, to permit the tap-root to descend perpendicularly, which it will sometimes do to the depth of 3, 4, or even 5 feet under favourable circumstances. Cold stiff clay soils, and others that are too compact, should be avoided, for in such the tap-root cannot penetrate in its natural direction, and the carrots become forked, as will likewise be the case in stony land. The Short Horn varieties may be grown on rather thin soil; but the long-rooted sorts ought to have a depth of 2 or 3 feet.

Manures.—Lime, potash, soda, and chloride of sodium, or common salt, are found abundantly in the ashes of the plant, and, accordingly, these substances may be applied with advantage as manures. Farm-yard manure laid on the surface and dug in is apt to make the roots fork. The best way of applying it is to trench the ground, and, in so doing, to let the manure be placed not nearer the surface than 18 inches. In this way, even fresh stable manure may be applied. Carrots are, however, generally sown without manure in soil that has been well-manured for the preceding crop.

Preparation of the Ground.—The ground, if not trenched, should at least be double dug, and it should also be thoroughly worked, so that it may be as nearly as possible of uniform consistence, and not richer at the surface than it is from 1 to 2 feet lower down. If the soil is of a uniformly soft and permeable nature, the tap-root will strike down quite perpendicularly, that being its natural disposition. It will neither diverge to the right nor to the left, if there be no impediment or temptation to the contrary; but if it have rich soil near the top and meet with hard poor soil below, the root will be apt to branch out, or fork into the good soil, and a deformed produce will be the consequence. The short-rooted sorts form exceptions to the above remarks. The Early Short Horn, for example, may be grown in a depth of about 6 inches of good or prepared compost, laid on the top of a natural soil of inferior quality. It will frequently be the case, that none of the soil of a garden is of the best description for the production of carrots. It may be too heavy; if so, it probably can be mixed with a large quantity of

sand, or sand and mud, the latter being of a light nature when dry; or clay and heavy soil may be burned and incorporated with the mass, and if sand can be added so much the better. Peat may also be employed in lightening the soil. If circumstances do not permit of these means being resorted to, it will be necessary to trench and ridge up the ground before winter, taking the opportunity of dry weather in spring to break down the ridges, and pulverize the soil by all possible means. Or holes 18 inches deep may be made with a large dibber, about 3 inches in diameter, and filled with prepared sandy compost. A few seeds may then be sown in each of the holes, and when the young plants come up, only the best one should be allowed to remain. Fine large carrots have been produced by this mode where the soil was naturally unfavourable to their growth.

Sowings.—A small quantity of the Early Horn should be sown on a warm border in January, or in the first week of February. Another sowing of the same sort, together with some of the Long Horn, may be made in the last week of that month, or in the first week of March. The main crop of the Long Horn, Altringham, and other large sorts for winter use, should be sown between the middle of March and the middle of April. If the weather and state of the ground be favourable, the earlier period will be proper in the northern parts of the kingdom. In warm soils, in the southern part, the middle of April will be early enough for the main crop. Small successional sowings of the Horn kinds may be made in June and July; and, finally, in the first or second week in August, a sowing of the Early Horn for spring use may be made, in a situation where some protection can be conveniently given during severe weather.

Carrots are either sown broadcast, on beds, usually about 4 feet wide, or in drills; but sowing in drills is preferable, as less seed will suffice, and the plants can be thinned more regularly. The drills should be very shallow. The distances may be, for the Early Horn, and other small sorts, 8 inches between the rows, and the plants should be thinned to 4 inches apart in the rows. Altringham, and others of similar growth, may be 10 or 12 inches from row to row, and the plants 6 inches apart in the rows. For larger sorts the rows may be from 12 to 15 inches apart, and the plants may be thinned to 8 or 10 inches

asunder in the rows. In soil where the carrot attains a large size, more space should be allowed than where smaller roots and tops are produced. In general, 12 inches between the rows, and 6 inches from plant to plant in the row, will be about a proper average distance.

The seeds of the carrot are hispid on the margin with forked hairs, by which they so adhere to each other, as to render it impossible to separate them till the hairs are broken by rubbing, and they cannot be regularly sown until they undergo this process, which can be effected between the hands, and which will be facilitated by mixing the seeds with some fine dry sand; with this addition they can also be more equally distributed in sowing.

The seeds of the carrot, like most others that give out a strong aroma, are apt to lose their germinative powers; it is therefore advisable to try their goodness before sowing. When well mixed, take out a small portion, and spread out thinly; then select, or rather take, just as they come to hand, a certain number of the seeds and sow them in a flower-pot, in gentle heat; when they come up, the proportion of good and bad seed in the lot can be ascertained. The seed, if proved to be good, should be sown very thinly along the drills, and only just covered with soil. The edges of the drills may be smoothed down with the back of a wooden-headed rake, or a little fine light soil may be put over the seeds, and in all cases where the ground is in good condition as regards dryness, a light roller should be passed over the whole surface of the ground. The process of sowing is then complete. Care should be taken to insert a small stick or two at each end of the rows, so that the intervals can be hoed if weeds start up before the carrots themselves appear.

In cold soils, and in sunless weather, the seeds lie long in the ground without germinating, and under such circumstances it would be as well in the seed-room. But to obviate this the seed may be steeped for twenty-four hours, and then kept in a temperature of about 55°, till germination commences, when it may be sown in the open ground. This plan may be advantageously adopted in cold situations, and where, from much wet, the ground cannot be worked at the proper time for sowing.

As soon as the plants can be well laid hold of, they should be thinned, and carefully singled out, where two or more have come up close together. At the same time, especially

as regards the Horn varieties, some should only be thinned to half the distance at which the plants are to remain for full growth: the intermediate ones will serve for drawing young, but they should be removed before their growth affects that of the plants intended to remain. It may here be remarked, that carrots are not usually transplanted; yet, as blanks are a loss of ground if left, and have an unsightly appearance if filled up with plants of a different species, transplanting may be occasionally resorted to. It is practised in France. If possible, take the opportunity of a moist time; and when the plants have only made two leaves, besides the cotyledons, remove them carefully with a ball, without breaking any of their fibres, and insert them in the vacancies. Some of the transplanting instruments may be advantageously employed in removing the plants.

After thinning, the usual routine of weeding and hoeing must be persevered in; but the surface should not be deeply loosened, for this would encourage forking, instead of a prolongation of the tap-root.

Taking the Crop.—Carrots are drawn young as required in that state. The main crop is taken up at the end of October or beginning of November, a dry day being chosen for the operation. This is performed by loosening the root with a fork, pulling by the top at the same time. Some cut off the tops a little above the crown; others cut off a small portion of the latter so as to remove all the crown buds. We prefer cutting as closely as possible to the crown, but not into the skin of the upper part of the root. The roots should then be stored in sand scarcely moist, but by no means over dry. The situation in which they are stored cannot be too cool, provided the roots are safe from frost. An underground cellar is therefore not the best place, for the temperature of such approaches that of the mean of the climate throughout the year; being colder on the average than any out-house in summer, but warmer in winter. Carrots should therefore be stored in an open shed, and not even in contact with the floor, for that, protected from cold by the mass of sand and carrots, would maintain nearly the annual mean temperature of the ground. The carrot bin should, therefore, be elevated, so as to admit of a free circulation of air between it and the ground floor. Or it may be in a loft with an open shed below. In either case, the roots

should be covered with as much sand as will prevent them from being affected by sudden changes of temperature. Carrots may also be stored in an airy shed, by piling them in the following manner, so that the crown may be outwards:—Select the longest roots for the lowest layer; lay them shoulder to shoulder, with their crowns towards the wall of the place, but not close to it—their tapering extremities will not of course touch each other; then place another layer in the same way, but with their crowns opposite to those first laid. Proceed thus with other layers, selecting always the next longest roots to those which formed the preceding layer, and, consequently, finishing with the shortest roots. The whole should have a sufficient covering of well-dried straw, or, preferably, of dry fern. They may also be thus arranged in the open ground, if it be dry, and then covered over with thin dry turf, leaving some openings, stuffed with straw, to permit the escape of exhalations, if any should be generated. Whatever mode of storing is adopted, no great bulk of roots should be put together, otherwise fermentation will be apt to ensue, and if it do, the flavour of the carrots will be deteriorated. In soils where maggots do not attack the roots, they may be left in the ground till towards spring, care being taken to cover them with litter in case of frost.

To save Seed.—This may be done either by leaving some plants in the ground, and protecting them from frost; or, in taking up the crop some of the finest specimens may be selected, their tops cut off at some distance from the crown, and preserved in sand till February or March, when they should be planted out about 18 inches apart in good soil enriched with decomposed manure. As the umbels successively ripen their seeds they should be cut off, and laid on a seed-cloth in the sun, to get thoroughly dry for rubbing out. Some recommend hanging up the stalks and rubbing out the seeds when they are wanted for sowing. Seed of more than one year old cannot be depended upon.

A peculiar method of saving the seed in India is described by William Inglecote, Esq., in the *Transactions of the Horticultural Society of London*, vol. v. p. 516, a modification of which might be tried with advantage in this country. It is called the Hyderabad practice, and has been in use near Seringapatam from time immemorial. A composition is formed of equal

parts of buffaloes' and swine dung, as fresh as can be procured, and red maiden earth; these ingredients are mixed into a smooth paste; a little water is added so as to bring the whole to the consistence of tar, and to about every 5 quarts, 3 drachms of asafœtida, dissolved in a small quantity of hot water, is added. The carrots, radishes, or turnips, are drawn when they have attained about one-third of their natural growth; the tops are cut off to within a few inches of the crown; a little of the tap-root is likewise cut off. Two incisions are made across each other entirely through the body of the vegetable, dividing it in quarters longitudinally from the lower end to within an inch of the crown. The roots are then dipped into the composition till well covered with it, both externally and internally, and they are immediately planted 15 or 16 inches apart, and 6 inches deep, so that the upper extremities only appear in sight. "Innumerable roots are thrown out from the edges of the incisions, and they consequently receive a greater abundance of nourishment, which, occasioning their luxuriant growth, causes them to yield, not only more than an ordinary crop of seed, but also of a superior quality." A mixture of cow-dung and rich maiden loam would probably answer the purpose quite as well. It was found that cow dung answered as well as that of the buffalo; it is also remarked by the writer of the paper above referred to, that the asafœtida may be useful in repelling destructive insects for a time.

Insects.—The carrot is attacked by several insects. When the plant makes its appearance above ground, it is attacked by the carrot plant-louse (*Aphis dauci*), which takes up its abode in the crown, and destroys the young plants. Dusting with newly-slaked lime is a good remedy. The larvæ of the carrot-fly (*Psila rosæ*) prove very destructive to this crop, by boring into the roots, causing what is called the "rust," and ultimately the death of the plants. A dressing of sand, saturated with spirits of tar, scattered over the ground previous to digging, at the rate of a gallon of spirits of tar to 60 or 70 square yards, prevents the attacks of this maggot; quicklime dug into the ground is also a good preventive. When the evil does appear, the plants attacked, which are easily known by the leaves turning yellow, should be immediately pulled up. The maggots of the crane-fly (*Tipula oleracea*), likewise do great mischief to the roots, which

are also attacked by the snake millepedes, wire-worms, and *Polydesmus complanatus*. To the seed crop much injury is done by the caterpillars of *Depressaria appiana*, *D. dancella*, and *D. depressella*, which devour the seeds and seed-vessels.

CAULIFLOWER (*Brassica oleracea Botrytis cauliflora*, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.)—According to Miller and others, the cauliflower, and likewise the broccoli, were introduced into England and the continent of Europe from Cyprus; but it is supposed that they had been brought to the latter place from some other country. It is stated in the *French Gardener*, 1658, and translated by Evelyn, that “they bring the seed of *cauliflowers* to us out of Italy, and the Italians receive it from *Candia* and other *Levantine* parts; not but that we gather as good in Italy, and France also, but it does not produce so large a head, and is apt to degenerate into the bosse cabbages, and navets; and therefore it were better to furnish oneself out of the Levant.” From this it appears that the cauliflower has been cultivated for ages in the island of Cyprus, and, doubtless, on the coasts of the Mediterranean. It succeeds well at Malta, and exceedingly well at Cairo—but, of course, only in the winter there. It is evidently indigenous to a warmer climate than that of Britain; for, unprotected, it would rarely withstand the severity of our winters, and would become extinct in a few years.

The varieties are not numerous; the principal are:—

1. **EARLY CAULIFLOWER**—syn. Early London White, London Particular, Mercer's New Pearly, Epps' Superb, New Dwarf Late Cyprian, Early Dutch.—Under each of the above names has been obtained a large, rather tall cauliflower, with a fine, white, compact curd, as the unexpanded head is termed. It is the sort cultivated near London for the early crop.

2. **WALCHEREN CAULIFLOWER**—syn. Walcheren Broccoli, Early Leyden Cauliflower, Legge's Walcheren Broccoli or Cauliflower.—Under the latter designation, this excellent sort has been extensively cultivated during the last ten years or more. It was originally introduced by the Horticultural Society of London, under the name of Early Leyden Cauliflower, and was obtained from Messrs. Schertzer of Haarlem. The stem is rather dwarf; leaves broad, less pointed, and more

undulated than those of the cauliflower usually are; the difference in constitution is, however, important, for it not only resists the cold in winter, but likewise drought in summer, much better than other cauliflowers. In hot, dry summers, when scarcely a head of these could be obtained, the Walcheren cauliflower, planted under similar circumstances, formed beautiful heads, large, white, firm, and of uniform closeness. As the late Mr. Legge, gardener at Bishopsthorpe, was very successful in the cultivation of this excellent variety, some remarks of his upon the subject may prove useful.

“For the supply of a family,” says Mr. Legge, “sow the third week in April, middle and end of May, the middle and end of June, and the middle and end of July. This attention will give a regular supply till the end of the year. I had a regular supply last year till 21st January. For the purpose of saving seed I recommend to sow my Walcheren broccoli at the time that the winter cauliflower is sown, say about the 25th or 27th of August, and winter the plants under hand-glasses as cauliflowers. Give them good soil, not too light, nor leave more than three or four plants under each glass, and let them be well attended to with respect to air.”—(*Journal of Horticultural Society*, vol. i. p. 309.)

3. **LARGE ASIATIC CAULIFLOWER**.—This was introduced into England from Holland under the above name. It is a very fine large variety, somewhat later and taller than the Early Cauliflower, and if sown at the same time, it will afford a succession.

Soil.—A rich, highly manured soil, such as that recommended for cabbages, will suit the cauliflower. It should in all cases be well drained, but a soil that is of too dry a nature is not well suited for the summer crop, as it stints the growth of the plants, and induces them to “button,” that is, to form a very small heart, not larger than a button, or about the size of the top of a broccoli sprout.

The manures recommended for cabbage and broccoli are likewise applicable for the cauliflower.

Sowings.—Where the climate is neither too cold for the cauliflower in winter, nor too hot and dry in summer, it flourishes at all seasons, and may be sown at any time without danger of not forming a head. Such is the case in climates like those of places in the Levant, whence this vegetable is said

to have been originally obtained. But it is different with us; for we cannot sow at all seasons with success, owing to the plant not being adapted to withstand the severity of our winters. The sowing may be made so late in summer that the winter will arrest the growth of the plant just before they commence to form a head; but, being too late to do that, they will, at the same time, be too early for keeping over the winter. They might be protected, but from having to linger so many months in an advanced state of growth, they would not form good heads on the return of active vegetation in the spring.

We shall comprise the different sowings in three periods:—

1. The autumn sowing, to produce in May and June.

2. The winter and early spring sowing, to produce in July and August.

3. The late spring sowing, to produce in September and October, or later.

From the different seasons at which these sowings are made, it will be evident, that the plants resulting from each will have to be reared under different circumstances, and that they will consequently require different treatment. It will be the simplest mode to treat consecutively of the management of the plants from each sowing.

1. *Autumn sowing, to produce heads in May and June.*

The time for this is, in general, about the 20th of August. In the warmest parts of the kingdom it may be as late as the 25th of August; in the north of England about the 15th; and in Scotland from the 1st to the 15th, according to the nature of the soil, and the climate of the locality. The seed-bed should be in an open situation, well exposed to light; the soil should be rich and friable, and, if well mixed, in digging, with some maiden loam, with which leaf mould has been incorporated, so much the better. Sow in drills 4 inches apart, and, if the weather is hot and dry, cover the surface with a mat, or other material, till the seeds begin to push. About three weeks after the plants appear above ground, they should be pricked out in good soil, in a cold frame. The surface of the soil, when filled in, should be within about 6 inches of glass. The plants should be pricked out to 4 inches apart, in rows 6 inches asunder. A few rows may have 6 inches from plant to plant in the row. From

the time the plants are established in the frame till they are removed from it, when the weather permits in spring, the aim should be to expose them to as much light and air as can possibly be done, consistently with that amount of protection which the severity of the weather may render necessary. The sashes should be kept on for a few days after the plants are put in the frame, till they strike root. Except in case of heavy rain, they may then be left uncovered till frosts occur, when the sashes should be put on at night. In very severe weather, when frost continues night and day, the sashes must be kept close. As the season advances, the plants ought to be more and more exposed; and before planting out, the sashes should be again dispensed with, in order that the plants may be hardened off. During the winter all dead leaves must be picked off; and if any plant is affected with mouldiness or mildew, it had better be removed; and, as a preventive, some flowers of sulphur may be scattered in the frame by means of a sulphurator. Slugs, and other enemies, should be carefully looked after, and to prevent their attacks a little quicklime may be strewed along the sides of the frame; and if some be scattered all over, it will do the plants no harm.

In the end of February, or as soon as the weather proves favourable, some of the plants should be taken up with good balls, and planted out in rich, well-manured ground, in patches of three or four, so that they may be covered with a hand-glass. Air should be given more or less freely according to the state of the weather. When the plants get too high for the hand-glasses, the latter should be raised by placing bricks beneath the corners, or, better, by putting another hand-glass on the top of the first. Dry turfy soil may be packed round the plants up to the lower leaves; at the same time a little earth may be drawn against the lower edges of the hand-glasses, when these are raised on bricks, to prevent a draught of air. The top of the hand-glass will require to be removed when the plants become large, and ultimately the whole of it. The hand-glasses thus set at liberty may be employed in forwarding successional plants.

Cauliflowers wintered in frames may, however, be obtained earlier by the following mode, which is practised near Paris. The cold there in February is generally greater than it is at the same period in this country;

we may, therefore, properly adopt the plan, even in cold situations. In the beginning of February a trench, about 18 inches deep, is filled with equal parts of dung and leaves, in alternate layers, to the height of 15 inches, in order to produce a slight bottom heat. The dung and leaves are covered to the depth of 9 or 10 inches, with a mixture of one-half decayed dung and one-half soil. Ten or twelve days after this is done, the cauliflowers are planted, 20 inches apart, and covered with *cloches*, or bell-glasses. Under each of these, four cabbage-lettuces are also planted. Some dry litter is placed between the glasses, and in severe frost they are covered with straw mats. In this way cauliflowers are obtained fit for use in April.

Instead of wintering in frames, cauliflowers are frequently planted out in the end of October or beginning of November, in patches 3 feet apart each way, and protected through the winter by hand-glasses. Six plants or more may be sheltered under each hand-glass during the winter; but with the exception of two or three, according to the size of the hand-glass, all should be removed as soon as the weather will permit in spring.

Sometimes cauliflowers are placed in front of a wall in the following manner:—A trench is taken out a foot wide, and not so deep as in any way to interfere with the roots of the trees. In this, about 6 inches thick of stable manure should be placed, and covered over with rich soil. The plants should then be put in at 6 inches apart. In spring remove two plants, and leave one alternately: those removed may be planted out elsewhere. After the cauliflowers are cut, the dung put in the bottom of the small trenches should be turned out and incorporated with the soil of the border, otherwise the roots of the trees might be induced to run in it too near the surface, and, consequently, be liable to be destroyed by future diggings.

Near London, the autumn-sown cauliflowers are pricked out 4 inches apart, in beds in the open ground, and protected by means of hoops and mats. In this way they are generally protected sufficiently from frost and rain; but in continued severe weather, the plants are apt to suffer from the want of light, and are then disposed to damp off. The labour required for covering and uncovering is considerable, and mats are not only expensive, but are soon worn out; glass will doubtless be

found a cheaper covering in the end, as well as the best adapted for the healthy growth of the plants.

Mr. Barnes, gardener to the Right Honourable Lady Rolle, at Bickton, sows his cauliflowers for spring, in the first week of October, in pans, in a little bottom heat; and about the end of the month, or in the first week in November, the plants are potted into small 60's or 3-inch pots, and these are plunged close to the glass. The plants are kept shifted on in some old melon mould, until in the beginning of January, when they are shifted for the last time into 7-inch pots. In the first week in February, the ground is prepared, and the places for the hand-glasses marked out. If wet, a little of the soil is taken out where each hand-glass is to stand, replacing it with some dry dusty rubbish, which Mr. Barnes states, is useful in preventing the cauliflowers from getting "black legs," a disease by which the stems become black, and spoiled. Four plants are turned out under each hand-glass. If the weather proves dry in March, a liquid manure, consisting of $\frac{1}{4}$ lb. of nitrate of soda to one hogshead of tolerably strong cow-dung water is prepared, and a few gallons of hot water are added. This mixture well repays the trouble, for the plants watered with it grow through the cold March winds, as in May, and fine cauliflowers are always produced early in April. Mr. Barnes, who is an excellent cultivator, states, that by shifting until the plants are in 12-inch pots, and then placing them in a vinery just put to work, or peach-house, he has had cauliflowers early in March.—(*Gardener's Magazine*, 1843, p. 433.)

Mr. Henry Baily, of Nuncham Park, gives a very clear account, in the *Journal of the Horticultural Society*, vol. v. p. 102, of his mode of cultivating the cauliflower. Mr. Baily grows only the Walcheren. He makes the first sowing for the spring crop about the 25th of August, and another for smaller successional plants, a week later in the open border. As soon as the plants are large enough, they are pricked out, and after having made a few roots are again transplanted into 3-inch pots. They are then placed in any open airy situation, either in a frame, vinery, or peach-house, which is dormant, the plants simply requiring protection from severe frost. "As they fill the pots with roots, larger ones are provided, and early in February, the

first crop or hand-light division is planted out in a south border; the holes for their reception having received a barrowful of rotten dung, the mould is returned, forming a little hillock on which three plants are placed, and covered with the glass till they begin to be established."

2. *Winter and early spring sowing, to produce heads in July and August.*

In order to obtain plants to form a succession to the crop produced by the autumn-sown plants, it is necessary to sow early in the season. As the ground at that time is generally too cold for the proper vegetation of the seeds, it is best to sow on a moderate hotbed, and rear the plants under glass. By so doing, we have it in our power to prevent the sudden checks to which they are liable out of doors. On the other hand, we must not grow them rapidly. A slow regular, and therefore substantial growth, is what we should endeavour to promote. When circumstances are conducive to quick growth, we may not be able to control it: for instance, the weather for some weeks may be unusually mild both day and night, for the season. All we can do in that case is to let the plants have as much air and light as possible; and if we do so, they will better resist the effects of continued severe weather which may subsequently occur.

That the plants may be allowed to grow slowly, the sowing should be made about the middle of February, on a moderate hotbed. When fit, the plants should be pricked out as directed for the autumn sowing; they may very well occupy the frames in which lettuce plants have been wintered. They should be planted out, some in the end of April, and some in May; the Walcheren, 2 feet apart each way; the others, $2\frac{1}{2}$ by 2 feet. If the potting system be adopted, sow the Walcheren about the middle of February; pot and shift as before directed. Where this system is not adopted for the whole succession, yet it is advisable to have some portion in pots, as, in case of emergency, recourse could be had to various means of bringing in the potted plants for use, when a failure in the supply might otherwise occur.

Besides the sowing in the middle of February for a principal succession crop, a small sowing may be made in heat in the first week in January, in case of clubbing or other accident to the autumn-sown plants; and another small sowing, also on gentle heat, may be made in the beginning of March.

3. *Late spring sowing, to produce heads in September, October, or later.*

In the first week in April, a sowing should be made in the open border. The plants may be pricked out, when fit, to 6 inches apart by 4 inches, but generally they are allowed to remain in the seed-bed till required to be finally planted out in June. This sowing should include the Walcheren, as it is not so liable to form buttoned heads as the other kinds.

The principal sowing for the latest crop should be made on an east or west border, about the 20th of May. The plants should either be kept very thin or they should be pricked out 6 inches apart each way, in fresh loamy but not stiff soil. If the weather prove favourable, they may be planted out in the end of July; but much depends on the weather, for if it is hot and dry, the plants being thin, the planting had better be deferred till rain come. Sometimes plants of the latest sowing do not form heads before frosts set in: in that case they may be divested of their outside leaves, taken up with a good ball, and planted nearly close together, in a cellar; or a pit, corresponding in length and breadth to the dimensions of a frame, may be dug out to the depth of two feet, and filled up with the materials of old hotbeds. On this the plants having been taken up with good balls, may be planted nearly close together, but they should not be watered. The frame and sashes are then put on, and the former surrounded with a lining of hot dung, which should be renewed when necessary. In this way, heads, not perhaps large, but fresh and good, may be obtained throughout the winter.

Taking the Crop.—The heads of cauliflowers may be cut when they are $2\frac{1}{2}$ inches in diameter, and from that till they attain their full size, but before they lose their compactness. The flower should never be exposed to sunlight, for that completely spoils its whiteness, one of its most valuable properties. Light is not essential to the growth of the head or flower, as the part used is termed. This in reality is no flower at all; it is a sort of monstrosity, composed of cellular tissue. The true flower is regularly organized, and for the proper development of its organs, light is absolutely necessary.

Modes of preserving from Frost.—When the heads of cauliflowers have once commenced to form, they will increase in size in the dark,

and without the assistance of the roots, if kept in a mild temperature. It draws substances for its formation out of the succulent stem; the heads may therefore be preserved for use, for a considerable time, by any means that will secure them from frost and damp. A nearly steady temperature, between 40° and 45°, will maintain vegetation; a gentle circulation of air will be sufficient, for if too great it would be apt to exhaust the juices of the plant, and to render the heads tough. Some recommend taking up the plant by the roots, and suspending it head downwards, in a place free from damp; others take up and replant in dry sandy soil in an open shed: this is a more natural plan than the preceding. Some bury the heads in dry earth, leaving a portion of the root sticking out above the ground to lay hold of in pulling up the plant. The head may also be divested of most of the leaves, and buried in peat earth. By these, and similar means, cauliflowers may be preserved in a fit state, so far as appearance goes, and even very good as regards flavour if no decayed leaves are allowed to remain. Peat, from its antiseptic properties, has been found to answer, but peat charcoal would be still better. Being a powerful deodorizer, it would prevent the effluvia which might otherwise arise from vegetation deprived of a free circulation of air. The only objection to employing peat charcoal arises from its dust adhering to the head; but this might be prevented by partially moistening the charcoal. Large bell-glasses, or *cloches*, with nightcaps of frigidomo, would answer well for protecting cauliflowers from such frosts as usually occur in November, or even till near the end of December. Glazed protections to extend along a row could now be constructed at little expense. They might be in the form of a ridge roof, or they might be 6 feet in length, and 18 inches in breadth, with an upright glazed front 15 inches high, a wooden back 18 inches high, and a glazed top hinged to the back sloping 3 inches to the front, and adapted for readily giving air when the weather permits.

To save Seed.—Seed is best obtained from autumn-sown plants which have been wintered in a frame. The selection should be made, and the plants marked, when the head is in perfection. Plants having short thick stems, with firm heads of a fine white colour, should be preferred. Those which exhibit a disposition to form a head before the generality

should be watched, and if with this disposition they do not quickly break the curd to run to seed, there is a chance that seed saved from them will be the best for early produce.

CELERY (*Apium graveolens*, L.—*Pentandria Digynia*, L.; *Umbellifere*, D. C.; *Apiaceæ*, Lind.) is a hardy biennial, a native of Britain, found wild by ditches, and in marshy situations.

Some of the varieties of celery have hollow or *pipéd* stalks, but as these are unworthy of cultivation, it will only be necessary to notice such as have solid ones. Of these the following are the principal:—

White.

1. **WHITE SOLID**—syn. Fine White Solid, *Céleri plein blanc*, *Céleri Turc*.—Of strong and rather tall growth; leaf-stalks generally solid, but when grown in very rich, highly-manured soil, they will sometimes become slightly hollow. Leaves palish green, with large and rather obtuse serratures. This sort blanches readily, is crisp, and of excellent quality; comes into use earlier than the red solid varieties.

2. **ITALIAN**—syn. Italian Upright, Upright, Large Upright, Giant Patagonian. — Tall, strong, erect; leaf-stalks deeply furrowed, sometimes a little hollow; leaves large, deep green, with large obtuse serratures. Not so crisp as the preceding, and can only be recommended for soups, and where very tall celery is desirable.

3. **WALL'S WHITE**.—An improved variety of the Italian, and esteemed by growers for competition, where quantity, not quality, is the principal consideration.

4. **SEYMOUR'S SUPERB WHITE**—syn. New Flat-stemmed White.—Moderately tall. The serratures of the leaves have pale tips; leaf-stalks solid, flat at the base, where they overlap and form a compact crisp, and, with ordinary care, a well blanched heart of excellent quality. May's Flat-stemmed White is closely allied to the above, as is also Seymour's White Champion.

5. **EARLY DWARF SOLID WHITE**—syn. *Céleri court hâtif*, *Céleri Turc* of some.—Rather dwarf, but thick-stemmed. The heart is remarkably full; the leaf-stalk solid, blanching promptly; there is, in fact, much more finely blanched substance in a plant of this variety, than in one of the tall sorts, and the quality is excellent. It comes into use rather early,

and it will stand the winter better than the other white kinds.

6. **CURLED WHITE**—*Céleri nain frisé*.—Dwarf and spreading. Leaves dark green, curled, resembling those of parsley, and like it might be employed for garnishing; leaf-stalks tolerably crisp and solid, but not finely flavoured. This sort, if not much earthed up, will stand the winter, and come in useful for soups in spring.

The following names occur in seed-lists, and designate good varieties of white celery:—Sutton's Solid White, described as being very sweet, large, and solid; Cole's Crystal White and Cole's Superb White, appear to be the same and closely allied to No. 5.

Red.

7. **RED SOLID**—syn. New Large Red, New Large Purple, New Russian, Cole's Red, Cole's Superb Solid Red, *Céleri violet de Tours*, *Céleri gros violet de Tours*.—The plant grows to a large size, full-hearted, with a thick stem. Leaf-stalks thick, deeply furrowed, and very solid, of a dark red or purplish hue where exposed, rose-coloured where partially blanched, but the perfectly blanched portion is pure white, more so than the blanched part of the white varieties of celery; it is also crisp and of excellent flavour. This is unquestionably the best variety of red celery.

8. **MANCHESTER RED**—syn. Large Manchester Red, Manchester Red Giant.—This scarcely differs from the preceding. It has acquired a rather coarser habit, with a somewhat rounder stalk, and this being the case, the heart is not so compact.

9. **SHEPHERD'S RED**.—Allied to the preceding, but has flatter stems, consequently it is more compact and better adapted for blanching sooner and more perfectly than the Manchester Red; to which, for these reasons, it is preferred by the growers for competition.

CELERIAC.

10. **CELERIAC**—syn. Turnip-rooted Celery, Knob Celery, *Céleri-rave*, *Céleri-navet* of the French, Knoll-sellerie of the Germans.—This is a variety of celery, the stem of which forms, under favourable circumstances, an irregular knob, and this is the part chiefly used, either sliced, as an ingredient in salads, or cooked. It is not so delicate to eat as the other kinds of celery, yet it is much esteemed on the Con-

tinental, especially where the frost is usually so intense as to render it impossible to preserve the other kinds fresh during winter; in this case celeriac becomes a valuable substitute, as its roots can be taken up and stored out of the reach of frost. On the Continent the roots are grown to the weight of from 3 lbs. to 4 lbs., but in this country they are not so successfully cultivated.

Soil.—A light rich and rather moist soil is best adapted for the growth of celery, whilst one which is heavy, wet, and adhesive, is unfavourable to it. Although the plant requires plenty of water, yet it is apt to rot in winter in cold heavy soils saturated with moisture. Provided manure is at command, a poor light soil is better than one that is stiff and rich; for the growth can be made to depend chiefly on the manure supplied, and the plant grows better when its leaf-stalks are surrounded with light porous soil, than when it is pressed against by that which is heavy and compact. The latter is mechanically injurious; for though the expansive power of vegetation in its natural state is very great, yet the blanched heart of a celery plant, not being in its natural state, cannot force its way against such heavy obstructions as it would do when in possession of its full vital energy; and when too much loaded or pressed by soil of a heavy nature, it must rot. Light sandy loam, well manured with cow-dung, produces good celery, provided plenty of moisture be afforded. Good peat soil, limed and manured, will also produce large heads.

Sowings.—For the early crops, the sowings should be on heat; and on the open border for the latest crop. For a very early crop, which will only require to be a very small one, a sowing should be made in the end of January, or beginning of February, in a pan of rich soil, decomposed dung, or leaf mould. The pan should be kept in moderate heat till the seeds begin to germinate, and then a very gentle heat is preferable. As soon as the young plants have made three leaves, they should be pricked out in boxes filled with old decomposed dung and leaf-mould; afterwards they should be kept near the light, and not allowed to draw up slender for want of air. If air and light cannot be duly afforded, the less artificial heat, the better. The leaves that are expanded by heat, with insufficient light and air, will make little more progress after planting out; on the contrary, they then

linger and die, and the plant, though apparently forwarded to a good size, is reduced to very small dimensions. Any vinery, peach-house, or frame where the temperature is from 50° to 55°, will be suitable for rearing early celery plants. This temperature will be about that of the open air in May, so that when the plants are then finally planted out, they will receive no check, the temperature to which they are exposed being not lower than that to which they had previously been accustomed. These remarks are applicable to other sowings which it may be thought desirable to make on heat.

The first principal sowing for autumn use should be made on gentle heat, under glass, in the last week of February, or about the 1st of March. When the plants have formed three leaves, they should be pricked out 2 inches apart in a compost of leaf-mould, very rotten dung, and a little rich friable loam, the whole well mixed and laid to the depth of 4 inches, on very slightly heating materials, and covered with a frame and lights, or with hand-glasses, if the former are not at command. When the leaves begin to meet, the plants should be again transplanted into the same kind of soil as before. The roots should be kept quite moist from the instant they are taken up until they are again placed in the earth. The tap-root should be a little shortened, especially if it be long in proportion to the lateral fibres. The plants should be inserted in rows 6 inches apart, and about 4 inches from each other in the rows. Water should be given as the planting proceeds, and afterwards it should be liberally supplied when required. In fine weather, the sashes should be drawn off so as to fully expose the plants during the day; indeed, they will only be required on for protection from the cold at night, and from frost, snow, and hail, at all times.

A second principal sowing should be made in the end of March, and as the ground at that season is generally too cold, it will still be advisable to sow, either in a frame or under hand-glasses, or bell-glasses may be used for the purpose. Bottom heat may be dispensed with; but the frame or glasses should be kept close and warm until the plants begin to appear, when air should be freely admitted at all times when the state of the weather will permit. The plants should be pricked out in the same kind of soil as that recom-

mended for the previous sowing, and in the same manner, only not on bottom heat. Before these pricked-out seedlings are in the least danger of being overcrowded, a piece of ground with a hard surface should be selected for a nursery bed, and a compost should be formed consisting of rotten dung, leaf-mould, and about a fourth part of rich friable loam, which may contain old fibre, provided the whole be well reduced by chopping and turning. This compost must be laid on the firm surface to the depth of 6 inches, and beaten close with the back of the spade, and afterwards thoroughly watered. As soon as the water has subsided, and the compost is not too wet for working, the plants should be transplanted to 4 inches apart, in rows 6 inches asunder. Care must be taken to keep the roots moist whilst out of the ground, and to shorten a little the long tap-roots before planting.

A third sowing for a late crop should be made about the middle of April, on rich soil or compost, on an open border facing the south. The plants, when fit, should be pricked out, and afterwards transplanted on a nursery-bed. In short, they should be treated in the same way as the plants of the preceding sowing.

Finally, a small sowing for some very late celery may be required to be made in May.

Preparation of the Ground for the Plantation.—Celery will bear to be flooded with water at the root when it is growing; but in winter, when it is making little or no growth, and is, moreover, in a blanched state, it is apt to rot if the roots and lower part of the stem are kept in a saturated condition. If the soil on both sides of the trench is hard, water will not readily escape from amongst the soft materials in the trench, and, consequently, they will be frequently too long maintained in that saturated condition which proves injurious to the plant when its vegetation is all but suspended. In order to provide against this evil, it will be advisable to trench the whole of the ground, at least two spades deep. Thus loosened, the soil will permit the water to percolate downwards, and laterally, so that no stagnation will take place.

Various modes of planting out have been practised and suggested. The mode generally adopted is in *trenches*, a single row being planted along the middle; or in *broad beds*, with the plants in rows across. The largest celery is grown in trenches; and in cold reten-

tive soils it is, doubtless, the best mode, as the ridge can be made to throw off the water in winter—an advantage which the flat-bed does not possess. On the other hand, the bed system affords more heads from the same space of ground. For instance, supposing a rod of ground to be planted in rows 14 inches apart, across a bed 6 feet wide, with the plants 9 inches apart in the rows, each plant will occupy 126 square inches. Allowing half a rod to be thus occupied, and the other half to be left for earthing up, the rod of ground will contain 155 plants. Now, supposing that trenches are formed 4 feet asunder, and that the plants are 9 inches apart in the trench, about 432 square inches must be reckoned for each plant; hence a rod will only contain 90 plants. According to this, the bed system affords 72 per cent. more than is obtained from the trenches, or for every three heads obtained from the latter, five, at least, would be obtained from the former. It will frequently be the case, that the total weight of the three will exceed that of the five; but when, in both cases, the heads are reduced to the heart portion fit for table, the difference will generally be in favour of the beds. For winter celery, trenches are, however, to be preferred; and if larger heads than those grown in beds are not desired from the trenches, the plants in these may be put closer together, say at 6 inches apart, and the trenches may be $3\frac{1}{2}$ feet apart, and then the number of heads per rod obtained from the trenches will exactly equal that from the beds.

Mode of Planting out in Trenches.—The ground having been prepared, the direction of the trenches, their distance apart, and their width, should be determined. Their direction should be north and south, as admitting the fairest exposure to light. The distance should be greater for tall than for dwarf growing sorts. It should not be less than 3 feet from centre to centre of the trenches, nor more than 6 feet. In small gardens, very good medium-sized heads may be produced in trenches 3 feet apart. When landed up, the ridges will necessarily be thin, and will consequently be easily frozen through; but this objection may be obviated by covering the ridges with litter, or other protecting material. Celery, as large as need be desired, and of better quality than that grown to a larger size, may be produced in trenches 4 feet apart. In general, this may be considered a good distance. Where

ground is plentiful, 5 feet may be allowed; and where the object is to have very large, tall celery, some make the trenches 6 feet apart.

Some recommend the trenches to be a spade's width, or about 12 inches; others, 18 inches, and some as much as 2 feet. We consider 12 inches too little, because the roots, when planted, will, in many instances, occupy 6 inches of the centre of the trench; then they can only extend 3 inches to each side without their spongioles, the principal feeders, coming in contact with soil beyond the limits of that which was manured, and specially intended for supplying them with abundance of nourishment. The trenches should not be less than 18 inches wide at bottom, and to this width the soil should be worked out and manured. When the distance between the trenches is 4 feet, or upwards, they may be formed 2 feet wide.

The depth of the trenches depends, in some measure, on the quantity or depth of manure intended to be introduced into them. It may be remarked, that the deeper and narrower the trenches, the slower will be the growth of the plants. These grow best, all other circumstances being the same, when their leaves are fully exposed to the light. The market gardeners near London dig the trenches two spades deep, fill in a foot deep of strong manure, and over that 3 or 4 inches of soil, and in this the plants are inserted. Near Manchester, where excellent celery is produced, the trenches are taken out 18 inches wide, and 1 foot deep; then 9 inches deep of compost is introduced; so that the plants are thus within 3 inches of the original surface. Where much manure is employed, as is the case near London, the depth of the trenches will require to be a little more than 1 foot; and where little manure is used, they should be more shallow; but in most cases, 1 foot may be considered a proper depth. The trenches should be cut with the sides as nearly perpendicular as the texture of the soil will permit, except near the top. They should be made, if possible, as wide at the bottom as at 9 inches above it. The other 3 inches next the surface, together with the soil taken out of the trench, should slope backwards. The object of this is to form a wide receiver for rain, and to expose the plants to a greater expanse of sky, and consequently to more light. If the trench were 18 inches wide, and the soil taken

out of it were laid on each side, and beaten up so as to form nearly perpendicular sides towards the plants, as is generally aimed at, the plants in the trench would get little more rain than would fall upon an area equal to the length of the trench by 18 inches wide. If a trench with upright sides is 32 feet in length by 18 inches in width, and if rain fall to the depth of a quarter of an inch, it will receive little more than $6\frac{1}{2}$ gallons; but let the earth be laid sloping, so that across the trench from the commencement of the slope on one side, to that on the other, is 30 inches, the quantity received will be 11 gallons, most of which will tend towards the roots of the plants. When heavy showers occur, nearly all the rain which falls within the limits of the slopes will reach the trenches; and celery, when in a vigorous growing state, cannot have too much water, and the rain water diverted towards the plants by the above arrangement, is more beneficial than if the amount were otherwise supplied by pump water; besides, a great saving of labour is effected.

The trenches having been dug out, manure should be introduced. This may consist of a mixture of horse and cow dung, or these mixed with old rotten dung, or a compost of rotten dung and fresh maiden loam, and if leaf-mould, or a little peat-soil, can be added, so much the better. Horse-dung should not be used in a dry littery state; it should be partially fermented, turned, and watered, till reduced to a moist consistency. The manure is usually turned over, and some soil turned up for planting in; but if the bottom is of a cold nature, it is better to use some of the top soil for this purpose, unless, indeed, the trench contains a sufficient depth of compost into which the plants can be inserted. The plants should be carefully taken up with balls by means of a trowel, and placed upright side by side on a hand-barrow. Previous to planting, each should be minutely inspected, in order that every offset or side-slip may be removed; and they should then be immediately planted. The distance asunder at which the plants may stand in the row varies from 6 to 18 inches. These are extremes; the latter should only be adopted where large heads are to be grown for competition. When the plants are far apart, they grow too strong, fibrous, and coarse. This should be avoided by planting 8 or 9 inches apart.

Mode of Planting out in Beds.—The ground should, in the first place, be marked out in 6-feet widths, commencing 3 feet from the north or south edge of the piece of ground. By this arrangement, the beds will run east and west, and the rows, when planted across them, will of course be north and south; the surface of the ground in the intervals will thus be directly exposed to the heating influence of the sun's rays at noon; whilst both sides of the row will be equally exposed to light. If, on the contrary, the rows were east and west, each would shade the ground behind it. Each alternate 6-feet space is dug out about a foot deep, and the soil laid right and left on the intermediate spaces. If the ground has not been previously trenched, the bottom, after the foot of soil has been taken out, should be deeply dug over, especially for late celery, in order that superfluous moisture may pass downwards. The directions for introducing the manure or compost into the trenches are also applicable to that proceeding as regards the beds. Near Edinburgh, where the bed system is preferred by the market gardeners, the plants are inserted 9 inches apart, in rows 14 inches asunder. Nicol directs that the rows should be 20 inches asunder, and the plants 8 inches from each other in the row. This gives 122 plants per rod, instead of 155, as by the former distances; but the rows may be 16 inches apart, and the plants 8 inches from each other in the rows; then the rod will contain 152 plants, very nearly as many as is obtained by the present Edinburgh practice. The greater space between the rows must be an advantage in earthing up, whilst the distance of 8 inches between the plants in the row will be sufficient for the size to which celery in beds is required to be grown.

Subsequent Culture.—This chiefly consists in watering, stirring the surface of the ground, keeping it clear of weeds, removing suckers or side shoots, and blanching. After transplanting, water should be given moderately, so as merely to keep the earth moist, but not saturated, till the plants take fresh root. Afterwards, abundance of water should be given, till a little before the plants are commenced to be earthed up. If manure has not been plentifully supplied, manure-water may be given occasionally; but it should not be strong, otherwise a rank growth is induced, and the flavour of the crop deteriorated.

Stirring the surface of the ground should be done when it is rather dry than moist, and care should be taken that the soil do not rest upon the hearts of the plants. The outside leaves possessed by the plant at the time of planting never grow to a large size; therefore, when more vigorous ones have been produced, these old and comparatively useless leaves may be removed. This should be done before earthing up takes place. When allowed to remain, they generally rot. In order to kill slugs, worms, and other vermin, the surface of the ground should be sprinkled with quicklime, and some, finely powdered, may be occasionally dusted thinly over the foliage. Salt may also be applied for the same purpose; when given in moderate quantities, it will not injure the plants.

Blanching.—A leaf, or leaf-stalk, grown in the dark is blanched, and the parts so treated are destitute of the green colouring matter, for the production of which light is essential. But the substance as well as the colour of plants grown in the dark is different from that of plants grown in the light. For instance, a potato will push in the dark a great length of white, tender, brittle stem; whilst in the light the stems are green, strong, and woody; and if the latter were, when nearly full-grown, taken into a dark place, its leaves would become of a faded green, and its stem dingy; the woody fibre of its stem, once formed, will still retain its toughness so long as it lives, and till it absolutely decays. So it is with celery: the part of it which we do not grow in the dark cannot be blanched, as it should be, white, crisp, and tender, by any subsequent seclusion from light. This, we think, is sufficient proof against the practice of allowing celery to grow nearly to its full size, and then earthing it up at once. We thus obtain a large plant from the number of leaves exposed to the light during a long period of growth. The stalks of the outside, or oldest leaves, are firm, with strong fibres, which render these parts totally unfit for use, except in cooking; a few of them will impart a strong flavour of celery, for the longer the plant grows in the light the stronger its flavour becomes. The next inner portion of stalks is of course paler, but not yet purely blanched and crisp, as they ought to be for salad. Lastly, we come to the centre, and there we find a comparatively small portion which is really fit for table. It is that which

has pushed up since the one earthing up was performed. It may be tolerably large in soil over a large quantity of manure, and which still retains a growing heat; but in cold soils the heart-growth after a single, and that a late earthing up, must be very small. It is evident that earthing up late, and once for all, is not to be recommended; neither, on the other hand, is too early earthing up advisable, for it prevents the plant from attaining a proper size. Before it can do this, it must have an extensive surface of healthy leaves exposed to light, to form roots and a thick base of stem. This cannot be the case if the foliage is either kept mostly buried in the soil, or otherwise crowded together. The plants must therefore be allowed to grow as freely exposed to light as possible for some considerable time after planting. At that stage their natural mode of growth should not be interfered with. When the earthing up is commenced, the soil should not be pressed too closely against the plants, for the heart-leaves must have room to push up; no soil ought to touch them, neither should the outside stalks be made to surround them closely till the final earthing up. As the plants advance in growth, the earthing up must be repeated at intervals of about ten days, or according as the weather proves favourable for the operation, which should not be performed when the leaves are wet, and the drier the soil the better. Some tie up the leaf-stalks loosely with matting, and then put the soil against the plants with the spade. The best plan, however, is to make some of the soil fine with the spade, and to put it with the latter adjoining to the plants on each side, but not against them. Then with both hands gather the stalks together, equally round, and as closely as may be thought advisable. When in right position, hold them with one hand, and with the other bring as much of the loosened soil against one side of the plant as may be necessary, then with the hand which did this, grasp the plant, and with the other hand bring up the soil on the opposite side. This operation is sooner done than it can be described. The heart is kept clear of soil, and the latter by this mode can be easily placed, and its quantity and position regulated, as we would wish. Until the last earthing up, at least, the soil should not be put higher than the tops of the set of leaves next to the outside ones. The leaf-lets of the latter will thus be left quite free,

and those interior to them should be sufficiently exposed to enable them to carry on their functions, and contribute to the growth of the stem and roots. At the earthing up previous to the final one, the soil ought to be put quite as high as the tops of the leaves next within the outside ones, and the latter should be brought closer together than formerly, in order that the growth, which subsequently takes place in the centre, may be almost dark, and it will be entirely so when more is closed in at the final earthing up. Celery, however, will keep better if the tops are left a little above ground. This can be done, and the centre be still kept deprived of light.

The principles upon which the preceding directions are based, are, to grow the plant up to a certain stage with all its foliage exposed to light as much as possible; to allow the outside leaves produced after transplanting to have full advantage of the light up to the latest period of earthing up; and to confine the next inner leaves only slightly till near the period just mentioned, so that they, together with the outer ones, may contribute to the sound growth of the stem and roots, enabling these to send up a full heart, which must be crisp and well blanched, in consequence of the light having been excluded from it during the whole period of its growth.

In giving these directions, the trench system has been kept in view, but the earthing up of celery in beds should be conducted on the same principles. The earth is best put to the plants by hand; but it has to be thrown in between the rows from the intervals between the beds, and, unless this is done with great care, the earth will get into the hearts of the plants. It will, therefore, be advisable to use two boards, about 9 inches wide, and in length equal to the width of the bed. These can be placed between the rows, so as to guard the plants on each side whilst the soil is being thrown in between. When a sufficient quantity is introduced, the boards are taken up and placed between the next two rows, and so on. Instead of boards, plates of stiff sheet-iron have been recommended—(*Gardeners' Chronicle*, 1849, p. 440)—and, if kept clean and free from rust, would doubtless answer the purpose very well.

Celery is usually blanched by means of the soil thrown out of the trenches, and that of the intervals; but other means are occasionally employed, and of these, perhaps, none more

successfully than sea-sand, direct from the sea-moistened beach. The salt does not injure the plants, and either it or the sand is disliked by the grubs, worms, slugs, &c., which spoil the stalks, so that in some gardens more than half the stems dug up are found unfit for use, or, at least, cannot be presented at table on account of their damaged appearance. Celery blanched by sand is clean, well blanched, and glossy; and where canker and the above-mentioned enemies attack the plant, sea-sand may be advantageously employed; or, if it cannot be had, clean river sand, or pure pit sand of any kind, free from oxide of iron, watered with a solution of salt, may be employed instead. In this case, the sand should be turned whilst it is watered, in order that the salt may be equally diffused throughout. In applying the sand, boards, or the sheet-iron plates, will be very convenient; they can be placed on each side of the row at a little distance from the plants, and the sand can then be introduced between the plants and the boards or plates, which can be backed up with soil to support the sand when they are withdrawn. Sifted coal ashes are sometimes used for blanching, but they frequently contain substances injurious to vegetation. The French sometimes blanch by tying up the stalks, first near the base, next about the middle, and, finally, near the top. The whole is then closely covered with dry straw up to the top of the leaves. By this mode celery blanches, it is said, quickly and well. Semicircular drain tiles, placed one on each side of the plant, so as to inclose it, have been tried, but not very successfully. If the whole plant is not covered in at top as well as at the sides, the blanching will be imperfect; if it be completely covered, then the leaves previously healthy in the light will become languid in the dark, and will fail to supply elaborated sap, and a good heart for blanching cannot be produced. The power to do this must be derived from healthy, unblanched foliage.

Protection.—Although celery, being a native of Britain, is a hardy plant in its natural state, yet under artificial treatment it is apt to perish in winter. At that season its oldest leaves, like those of other herbaceous plants, naturally begin to decay, and the central portion, though young, is unfitted for resisting frost, in consequence of its having been blanched. The alternate action of frost and wet soon causes it to rot, and frequently wet alone has

this effect. Melting snow and hail, descending to the centre, check the growth, and rottenness frequently results from this cause. It might, in some measure, be prevented, by inclining the upper part of the plant in earthing up. In the usual way the stalks are kept upright, so that water from snow melting on the top readily passes down amongst them; but by bending the tops towards one side at the last earthing up, or even commencing to do so at the previous earthing, the rain or snow water would not have a direct downward course. For example, suppose we take a bundle of willows, and place them erect, and up to the top in a ridge of earth; the interstices between the willows would be like so many tubes through which water would quickly pass down, and so it would among the celery stalks. If we bend the tops of the willows to one side, and cover the bend over as far as its summit, it is evident that no rain can then pass down as before, neither would it pass along the course of the bend of the celery. In adopting this plan, one side of the ridge would necessarily be higher than the other. Tough dry turf, or some substance that would not wash down into the hearts of the plants, might be laid on the upper side of the bent celery tops. Various other means of protection could easily be devised. Inch-square deal rods could be driven in opposite to each other on each side of the ridge, and distant across about a foot. Cross pieces might be nailed to these about 6 inches above the tops of the plants, and on them rods, 10 or 12 feet long, might be laid. Over these, neat straw mats could be made to fit, so as to be readily applied when protection against frost and snow is required. The width of each straw mat should be 3 feet, or more, according to the length of the straw, and two of them joined together will fold over the ridge rod, and hang down on both sides, affording sufficient protection from snow, and also frost, if it is not excessively severe. The mats should be rolled up during the day, if the temperature is not then below freezing; but when the weather is wet, and severe frost is not apprehended, the ridge rods should be shifted towards the windward side. Then fold the mats or otherwise place them so that they may slope over the plants, from the horizontal rod, on the side next the wind and wet, leaving the other side open to the influence of light. Thatched hurdles afford good protection. Mr.

Duncan uses leaves which have been previously heated, and remain in flakes of some 6 inches in thickness, and which resist alike the action of frost and moisture. This covering is removed in favourable weather, and the plants exposed to air, as they should be in all cases. Dry fern, long litter, or any other substance that will form a light covering and resist frost, may likewise be used. Some plants may also be taken up and buried in sand or light soil, under shelter, leaving, however, the tops of the leaves uncovered.

Culture of Celeriac.—This should be sown early in March, and for succession in April, in a slight heat under glass, or under a hand-glass on a warm border, and afterwards pricked out like other celery. In the beginning or middle of June the plants should be planted out on the level ground in moderately rich and rather sandy soil, in rows 18 inches apart, and at 1 foot from each other in the rows. Before planting, all lateral shoots, and some of the outside leaves, likewise the lateral fibres on the root, must be removed. The plants ought to be planted shallow, the roots scarcely so deep in the ground as they had formerly been. Abundance of water should be supplied. Occasionally a little of the soil must be taken from around the bulb, and all lateral fibres removed. When nearly full-grown the bulb should be covered with a little soil to render it whiter than it otherwise would be. The roots will be fit for use in September or October; and before winter part of the crop may be taken up, divested of all the foliage except the heart-leaves, and placed amongst sand in a shed or cellar. The roots left in the ground will only require protection in very severe weather.

To save Seed.—Select some of the finest plants, mark them in order to give them but very little earthing up, and protect them in severe weather. Early in spring they should be carefully taken up and planted in a sunny situation. They should be well watered, and the flower-stems supported by stakes. The seeds ripen in autumn, and keep good for three or four years; but the newest seed is the best.

Insects, &c.—Celery suffers from the attacks of the celery-fly (*Tephritis onopordinis*), which lays its eggs in or upon the leaves, and the larvæ produced feed upon the parenchyma of the leaves, forming large blisters. These maggots are found from June to November, and

the only way of limiting their numbers is by pinching the blisters as soon as they appear, and cutting off and burning all the blistered and spotted leaves that can be removed with safety to the plant. Another insect injurious to celery is *Piophilæ apii*, the maggots of which burrow into the stems and stalks of the plant, completely spoiling their appearance, and rendering them unfit for use. Considerable mischief is also occasionally done by the mole-crickets, which dig under the plants, and eat off the roots. Snails and slugs are also destructive visitors.

Celery is liable to canker in some soils, particularly in such as contain much oxide of iron. A parasitic fungus also grows upon the leaves.

CHAMOMILE (*Anthemis nobilis*, L.—Syngenesia Polygamia Superflua, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a hardy perennial, a native of Britain, where its flowers have long been used as a stimulating tonic. A strong infusion of them also acts as an emetic when taken warm.

There are two varieties, the *single-flowered* and *double-flowered*, the latter is that usually cultivated for sale, on account of the greater bulk of its flowers, which, however, are inferior in activity to those of the single flowering sort. Chamomile prefers a dry soil, and though it may be raised from seed sown early in spring, is usually propagated by dividing the roots in March, or in autumn, or by offsets. The divisions should be planted in small patches, 9 inches apart, and water should be given at planting, and subsequently till they take root; after that they soon spread and cover the ground. The flowers ought to be gathered when just opened, and successively as they are produced; and after having been gradually and thoroughly dried, they may be stored like other herbs.

CHERVIL (*Anthriscus Cerefolium*, *Scandix Cerefolium*, L.—Pentandria Digynia, L.; Umbelliferæ, D. C.; Apiaceæ, Lind.) is an annual plant, a native of the Continent, cultivated for the leaves, which, when young, are used in salads, and to flavour soups.

The varieties cultivated are:—

1. COMMON CHERVIL.
2. CURLED CHERVIL—*Cerfeuil frisé* of the French.—A very pretty variety; the beautifully curled leaves of which are used as a garnish, and for the same purposes as those of the common sort. It is the kind generally

preferred. To keep it true, seed must be saved from plants with well-curved leaves.

Chervil may be sown either broadcast and lightly raked in, or in shallow drills, 8 inches apart, covering very lightly with mould. If a constant succession of tender leaves is required, seed must be sown every month or three weeks, from the end of February till September, when a small quantity may be sown for winter and spring use. In summer, it should be sown in a shady situation; at other times any aspect will do.

CHICORY, or *Succory* (*Cichorium Intybus*, L.—Syngenesia Polygamia Æqualis, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a hardy perennial, a native of Britain, where it is found growing by road-sides, and in waste places, particularly in calcareous soils. In the garden it is only grown as a salad plant, and as such it is not so generally cultivated as it deserves. The leaves, when cut quite young, constitute a rather bitter but very wholesome small salad, much esteemed at Paris, but seldom used in this country. When blanched, the leaves furnish the excellent winter salad known by the name of *barbe de capucin*. The large fleshy roots are cultivated on an extensive scale for mixture with coffee, on the inferior sorts of which its addition effects a decided improvement. For this purpose the fresh roots are cut into small pieces, dried on a kiln, roasted, and ground. The leaves are also an excellent fodder, and are greedily eaten by cattle of all kinds.

The varieties are:—

1. COMMON CHICORY.
2. COFFEE CHICORY.
Chicorée à café.
3. IMPROVED CHICORY.
Chicorée sauvage améliorée.
4. VARIEGATED CHICORY.
Chicorée sauvage améliorée panachée.

The second sort has fleshy roots like those of carrots, and as long. It is the kind grown for mixture with coffee; but the leaves may be employed in salad like those of the others. The third sort is an improved variety, the leaves being large and pressed together so as to form a sort of heart, like Batavian endive. It was raised by M. Jacquin, seedsman, of Paris, who has also found that it is tolerably good when boiled. The leaves of variegated chicory have red veins, which change to a beautiful bright red in blanching.

If chicory is grown as a small salad, it may

be had all the year round by sowing every fortnight or three weeks in the open ground, or on a hot-bed, according to the time of the year. In general, however, sowings in the open ground from the end of April to the end of October will be sufficient, as the blanched leaves are used during the interval. When sown for this purpose, the seed should be thickly sown broadcast; and in summer a cool shady situation should be chosen. Watering is all that is required till the plants are fit for cutting over, which should be done as soon as they have made the first three or four leaves.

Cultivation for Blanching.—In order to obtain the blanched leaves of chicory, several modes of cultivation have been recommended; and, according to circumstances and convenience for forcing, one or other of these methods may prove the most eligible. We shall, therefore, lay before our readers several modes of proceeding, so that they may choose the one best suited to the means at their command.

Mr. Fleming, of Trentham, in an article in the *Gardeners' Chronicle*, recommends the following mode of cultivation, in addition to which he makes some excellent observations on the different modes of blanching, which we shall also extract:—

“An open border,” says Mr. Fleming, “should be chosen for this plant, and as it produces long carrot-shaped roots, the soil should be deep, rather light, and moderately rich. Fresh manure should not be applied unless the ground is very poor; and when it is really necessary, guano will be found preferable to that from the stable. If guano is used, it should be sown broadcast over the beds as soon as the plants are fairly up. The ground should be double dug and well pulverized to the full depth, in order that the long tap-roots may meet with no impediment in their downward progress. About the middle or end of June, the seed should be sown in drills, 16 inches asunder. If the seed seems good it should not be sown too thickly, for the plants must be thinned out to the distance of 8 inches from plant to plant. This is a much better method than sowing in a bed and afterwards transplanting, as they are liable to lose their tap-roots during the operation, to obviate which, is an essential point in their successful cultivation. As snails are particularly fond of chicory, especially when the plants are young, it will be advisable to sprinkle a little

quicklime over the beds as soon as the plants are above ground. Nothing more is necessary, except to fork between the rows before the leaves cover the ground, and afterwards to keep the beds free from weeds. By the end of November the larger leaves will have decayed, leaving only a few small ones in the hearts of the plants. At this time they should be taken up and neatly laid in at the back of a north wall, to prevent the undue excitement occasioned by warm summer weather. Care should be taken to injure the roots as little as possible during this operation.

“About a fortnight before the blanched leaves are required for use, a sufficient quantity should be removed into a spare corner of the mushroom-house, or some similar place, where they can have a little heat. They should be planted in old tan, sand, or some other light material which contains just sufficient moisture to set the fibres in motion. In planting, the crowns should stand at least $\frac{1}{2}$ inch above the surface, and any loose soil should be removed from about the leaves with a syringe, in order that the young foliage may be perfectly clean when cut. In the space of ten days the leaves will have made a vigorous growth of as many inches, and if they have grown in perfect darkness the colour will be a delicate creamy white. When the leaves are about a foot high they will be ready for use, and as soon as they are cut the roots should be removed and others brought forward to succeed them. After the earlier forced roots are removed they may be returned to the north border, and have a little old tan strewn over their crowns. Here their strength will in some measure be recruited, and they will bear forcing a second time, and will produce a second crop of leaves towards the middle or end of March. These leaves will be produced from the lateral buds around the base of the crown, if in the first cutting it has not been pared too close; they will scarcely be so fine as the first crop, but will prove very useful late in the season, if the supply of roots is limited.

“An easy, and at the same time an effectual method of blanching chicory leaves is to have a few wooden boxes constructed, about 12 or 14 inches deep, and to invert these over the plants. Each box should be large enough to cover a sufficient number to supply a respectable salad for a week, which will vary from one to three dozen, according to the require-

ments of the family. By proper attention to removing the old roots in rotation, and substituting fresh ones in their places, a supply of excellent salad may be obtained from a space large enough to hold three of these boxes.

"Any one who possesses a garden in which to grow the plants in summer, may blanch them in a cellar, with equal facility, if it is kept sufficiently dark, except that it will require three weeks to produce leaves of the requisite length. If the cellar is used for this purpose, it will be the readiest way to form a stack in one corner, and lay the roots horizontally in sand as you would to preserve carrots. The roots should not be all put in at once, but a layer or course of roots should be brought in once a-week, and by the time the fourth course is in, the first will be ready to cut. Under this system the old roots should not be removed, but retained to produce a second cutting; and by taking advantage of this property, it will not be necessary, after the first four or five weeks, to bring in a fresh supply of roots oftener than once in a fortnight or three weeks. The roots should be laid about 3 inches asunder in quincunx order with those below them, and with about 3 inches of sand between the courses. I flatter myself that this hint will be particularly useful to the denizens of towns, in pointing out to them a cheap method of procuring the luxury of a first-rate winter salad.

"It is worth while to remark, that as chicory commences its growth very early, the blanched leaves may be obtained out of doors in the months of February and March, by planting the roots in a moderately dry border, and inverting a close box over them, in the same manner as directed for growing them in the mushroom-house. By this method a somewhat longer time will be necessary to produce leaves of the requisite lengths, for which reason it will only be resorted to when other means are not convenient."—(*Gardeners' Chronicle*, 1849, p. 308.)

The French, who excel in the production of *Barbe de capucin*, adopt the following modes of treatment, the account of which we translate from the *Bon Jardinier*:—"The seed is sown thinly in April or May. In November or December, one or several beds of light sandy soil, or well-decomposed dung, about 2 feet in width, and 3 inches thick, are formed in a cellar. On these is placed a row of chicory

roots laid on their side, with the crowns outwards; next comes another layer of earth of the same thickness as before; then another row of roots, and so on. The mild and equable temperature of the cellar, and the want of light, soon occasion the production of blanched leaves, which are cut as soon as they have attained a sufficient size. Water must be given as required if the soil used is too dry. Near Paris, a more expeditious method is pursued; beds of hot dung are made up, and the roots of chicory, tied up in bundles, are placed in an upright position upon the beds, and watered from time to time, so as to keep them moist. Another method of blanching without taking up the roots, consists in sowing in drills from 6 to 8 inches asunder, and covering the chicory in February with 4 or 5 inches thick of earth, or with double that thickness of leaves. In three weeks or a month afterwards, according to the season, it pushes, and as soon as it appears above the additional soil or leaves, it is cut over by the original level of the ground. In this way the leaves are very white and tender."

Another mode of blanching consists in boring holes in a cask with an auger, in rows 3 inches asunder, and filling it up with alternate layers of sand and roots, with the crowns protruding through the holes. The cask is then placed in a dark cellar, and the sand is moistened if it becomes too dry. In this way several cuttings of blanched leaves may be obtained till the roots are exhausted. This method is sometimes adopted on board of ship.

In order to save seed, a few plants may be left through the winter. They will flower in July and August, and ripen their seed in autumn.

CHICKPEA, The, or Egyptian Pea (*Cicer arietinum*, L., Fig. 156—*Diadelphia Decandria*, L.; *Leguminosæ*, D. C.; *Fabaceæ*, Lind.) is an annual plant, a native of the south of Europe, where it is much cultivated for its seeds. These, though not very digestible, are largely employed in soups, and form the basis of the *purée aux croutons*, so highly esteemed at Paris.

Three varieties are distinguished by Noisette, one having *yellow*, another *white*, and the third *red* seeds; the flowers of the first two are white, those of the last sort rose-coloured.

Except in warm summers, the seeds do not ripen well in this country, but would do so in

most parts of the United States. Sow, like pease, early in spring, in drills 3 feet apart,

Fig. 156.



and gather the pods a little before the seeds are perfectly ripe.

CHIVES (*Allium Schoenoprasum*, L.—Hexandria Monogynia, L.; Liliaceæ, D. C.; Liliaceæ, Lind.)—This is a hardy perennial plant, a native of Britain, cultivated for the leaves, which are cut over by the ground, and used in salads and soups instead of young onions.

It prefers a rich warm soil; but will grow well in almost any soil or situation. It is propagated by dividing the roots in spring or autumn, and planting them in small patches, 6 inches apart, in rows from 9 to 12 inches asunder. The plants soon form large bunches of leaves, which become the more tender the more frequently they are cut. Chives will grow in the same spot for four or five years, after which the plants must be taken up, divided, and replanted in fresh soil. The ground between the rows should be hoed occasionally. Some cut the plants over at the end of autumn, and after leaving them for some time to dry, cover them with an inch or two of mould.

CIBOULE. See ONION.

CLARY (*Salvia Sclarea*, L.—Diandria Monogynia, L.; Labiatae, D. C.; Lamiaceæ, Lind.) is a biennial plant, a native of Italy. The leaves are occasionally used in soups. Sow in April, in drills 18 inches apart, and when

the young plants are 2 or 3 inches high, thin out to 1 foot asunder in the row. Or, sow broadcast in a bed, and transplant to the above distances. The subsequent culture is confined to keeping the ground clean, and stirring it by an occasional hoeing. The leaves will be fit for use till the following summer. The plants flower in August, and die off soon after the seed is ripe.

CORIANDER (*Coriandrum sativum*, L., Fig. 157—Pentandria Digynia, L.; Umbelliferae,

Fig. 157.



D. C.; Apiacæ, Lind.) is an annual plant, a native of the south of Europe, though it is

said to be occasionally found wild in some parts of England.

Its young leaves are put into soups and salads, and the seeds are extensively employed in confectionary, for disguising the taste of medicines, and by distillers; they are also used in soups, and some other made dishes.

It succeeds best on a warm loamy soil; and may be sown thinly, either broadcast or in drills 1 foot apart, in September, or about the middle of February, or in March, according as the season is favourable or otherwise; in some soils, however, the plants from seed sown in spring are apt to die off at the time of flowering. If grown for the leaves, a small quantity may be sown every six weeks throughout the spring and summer. The ground must be hoed occasionally till the seed ripens, which will be the case in August.

CORN SALAD, or **Lamb's Lettuce** (*Valerianella* Dufr.—*Triandria Monogynia*, L.; *Valerianæ*, D. C.; *Valerianacæ*, Lind.) is much esteemed in France as a small salad, and as a substitute for lettuce during the winter and spring.

Three sorts, all of which are annuals, are cultivated:—

1. COMMON CORN SALAD (*Valerianella olitoria*, D. C.)
2. ROUND CORN SALAD.
3. ITALIAN CORN SALAD (*Valerianella erio-carpa*, D. C.)

The second sort, the *Mâche ronde* of the French, is superior to the first; its leaves are thicker and of a darker green than those of the other corn salads. The Italian corn salad, *Mâche d'Italie*, or *Régence*, of the French, is said to belong to a distinct species; its leaves are larger and of a lighter green than those of the common sort; they are occasionally used early in spring instead of spinach, for which they form a very good substitute.

Corn salad is raised from seed, which should be sown on a bed or border of light rich earth, manured the preceding year. It may either be sown broadcast, and lightly raked in, or in shallow drills 5 or 6 inches asunder. All the culture required is confined to watering the seed-bed, and young plants, in dry weather, and to protecting them with long litter during severe frost. The plants will be sufficiently thinned by removing the most advanced for consumption, leaving the youngest to come in for use in succession.

The first sowing may be made in the beginning or middle of August, and from that time

till the end of October, a small quantity may be sown every week or fortnight, according to the demand. These sowings will afford a supply for autumn, winter, and early spring use. If required in the latter part of the spring, and in summer, it may be sown monthly from the beginning of March till the end of July. Seed is saved by allowing some of the plants to run, and, as it is easily shed, it must be gathered as it ripens; in doing this, a cloth is spread under the plants, which are then shaken; this having been repeated on several occasions, as the seed successively ripens, the plants are carefully pulled up and hung up in a shed to ripen the remainder of their seed. The seeds remain good for six, or even eight years.

COSTMARY, or **Alecost** (*Pyrethrum Tanacetum*, D. C.; *Balsamita vulgaris*, Willd.; *Tanacetum Balsamita*, L.—*Syngenesia Polygamia Æqualis*, L.; *Compositæ*, D. C.; *Asteracæ*, Lind.) is a perennial plant, a native of the south of France and Italy. The leaves were formerly put into ale, and are occasionally used in salads. It prefers rather a dry soil and a warm situation. Propagate by parting the roots in spring or autumn, and plant the divisions 2 feet apart.

CRESS, **American** (*Barbarea præcox*, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicacæ*, Lind.)—The American or Belleisle cress is a perennial plant, a native of England, growing naturally by the sides of brooks. The leaves are used for the same purpose as those of the common cress. It prefers a light and somewhat moist soil. It is raised from seed, which should be sown thinly in shallow drills 9 inches asunder, thinning out the young plants to 4 inches apart in the row. A sowing for winter and spring use may be made in the beginning of September. To have tender leaves in winter, some plants of this sowing should be transplanted to 3 or 4 inches apart, so that they may be covered by hand-glasses in severe weather; or they may be protected by spray, covered with dry litter. If required in summer, it may be sown in a warm situation in March, and in a shady spot in May and July; but if in constant demand, it should be sown monthly from March till September. All the culture it requires is to water occasionally in dry weather. In gathering, the plants may either be cut over like mustard and cress, but not too close to the ground; or the leaves may be gathered singly; in either case, fresh leaves for another gathering will be produced.

CRESS, Garden (*Lepidium sativum*, L.—*Tetradynamia Siliculosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.)—The garden cress is a hardy annual, which has been cultivated in this country since 1548. It is supposed to be a native of Persia.

The varieties are:—

1. **COMMON CRESS**.—The sort most generally grown. It is sown and treated in the same way as mustard.

2. **CURLED CRESS**.—Used as a salad and for garnishing. Unless carefully saved, it is apt to degenerate.

3. **GOLDEN CRESS**.—Dwarf, yellowish green, slower in growth than the preceding, and of a mild flavour.

4. **BROAD-LEAVED CRESS**.—A coarse sort, seldom grown, except for feeding poultry.

5. **NORMANDY CRESS**.—This is a very hardy and excellent sort of cress. The leaves, being finely cut, also make a good garnish. It was first brought into notice by Mr. McIntosh, who speaks highly of its merits. He considers that five sowings are enough to afford a succession throughout the year. For winter and spring use it should be sown at the foot of a south wall, in the beginning of September, and again about the middle of October. For a succession, sowings may be made in an open border in March, April, and May, choosing a shady situation for the May sowing. The seeds should be sown thinly, in rich soil, in drills 4 inches apart. In gathering, instead of cutting the plants over, the leaves should be picked; after this operation fresh leaves are soon produced.

CRESS, Water (*Nasturtium officinale*, Br. *Sisymbrium Nasturtium*, L.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.)—The water cress is a hardy perennial, a native of Britain, where it is found growing in ditches and small streams. It is considered to possess antiscorbutic properties; it is also said to contain iodine, to which, probably, some of its virtues may be attributable. Near Rickmansworth in Hertfordshire, at Springhead near Gravesend, and at Waltham-Abbey, Essex, it is extensively cultivated for the London market, which also receives supplies of this salad from the banks of the Thames and other waters, in which the plant naturally grows. At Erfurt, and in the neighbourhood of Paris, large quantities are also grown. It is propagated by seed; but, in forming plantations, seedlings from the natural habitat of

the plant, or rooted divisions, are usually employed.

The best information respecting the cultivation of this plant is contained in a paper by Henry Bellenden Ker, Esq., in the *Horticultural Transactions*, vol. iv. p. 540, describing the mode of cultivation adopted by Mr. Bradbery, at West Hyde, near Rickmansworth. Of this account the following is the substance:—

Mr. Bradbery conceives that there are three sorts of this vegetable; the first he calls the *Green-leaved*, the second the *Small Brown-leaved*, and the third the *Large Brown-leaved*. The three sorts he considers to be the same in taste, but some are more fitted than others for particular waters. The *Green-leaved* is the easiest of cultivation, and the *Small Brown-leaved* is the hardest; whilst the *Large Brown-leaved*—which, on account of its appearance, and probably also from its having a less proportion of stalk to the leaf, is preferred in the market—is the only sort he cultivates, and is the only one which can be well grown in situations where shallow water is not to be obtained. At Northfleet, Springhead, where Mr. Bradbery first began to cultivate the water cress, it was soon perceived that the plants grew better, and had a superior flavour, when disposed in rows parallel with the course of the stream, than when left in irregular patches. When in rows, the plants are more regularly exposed to the influence of the current, and the water is not so much impeded in its course, because there are regular open channels between the rows. The cress is also more easily gathered from the rows; and more readily freed from weeds, and the different matters which pass down the stream, and become entangled with the plants. Mr. Bradbery, having left Northfleet, began to plant beds of the cress at West Hyde, near Rickmansworth. It was found necessary to vary the spaces between the rows, according to the depth of the water. When it is deep the rows are 5, 6, and even 7 feet apart, whilst, in shallow waters, about 18 inches space between the rows is considered as sufficient. The plants are found to thrive best in shallow water; that is, when the depth is about 1½ inch, which increases to about 3 inches when the plants begin to grow, and thereby to check the current. In deep water the roots are easily drawn out of the soil, which makes it difficult to gather the vegetable freed from the roots; if, therefore, a sufficient space

covered with shallow water could be obtained, the deep water would not in any case be used.

The shoots are cut for market, not broken off, which is the usual mode of gathering the wild cress, a practice which is found to be very injurious to the plants in the beds. After frequent cuttings the heads are found to grow small.

The most expensive part of the cultivation is the necessity of clearing out and replanting the beds twice a-year; as the mud quickly collects about the roots, and the duck-weed and other plants become intermixed with, and choke up the cress, it is almost impossible to pick it in a fit state for market after the plantation has been made five or six months.

The mode of replanting is to remove all the rows of plants, beginning at the stream-head, and then clear the bed of the stream from mud and rubbish; which, however, it should be remarked, make excellent garden manure. From the mass of plants thus taken out, the youngest and those with most roots are selected; these are placed on the gravel in rows, at the requisite distances, with a stone on each plant, to keep it in its place.

The cress will not grow freely in a muddy bottom, nor will it taste well when there is mud about the roots, which should be carefully removed and replaced by gravel or chalk. It is absolutely necessary to have a constant current, as when there is any obstruction to the stream or flow of water, the plants cease to thrive. The times of renewing the beds are May and June, and from September to November. The planting is done in succession, so that the crops may come regularly into cutting. Those planted in May are fit to cut in August, and those planted in November are ready to gather in the spring.

After the plants have been cut about three times they begin to stock, and then the oftener they are cut the better. In summer it is necessary to keep them very closely cut; and in water of a proper depth, and with a good soil, each bed supplies a gathering once a-week. In winter the water should be rather deeper than in summer (4 or 5 inches); to obtain this the plants are left with more head, that the water may thus be impeded.

It is essential that the plantations should be made in fresh or newly risen spring water, as the plants not only thrive better in it, but in consequence of its being rarely frozen, they generally continue in vegetation, and in a good

state for gathering through the whole winter season.

Water cress may also be grown in a shady border of rich soil, covered with a thin layer of sand to keep the leaves clean, and kept constantly moist by frequent waterings; but in this way the produce is inferior in quality to that obtained from plants grown in water. It may be also grown in tubs partially filled with soil, which is covered with water. The water should be frequently drained off and replaced by fresh.

The cocoons of the water-cress fly, *Tipula reptans*, as well as the eggs and larvæ of various other insects, are found on the water cress, and sometimes cause much inconvenience when eaten; the leaves should therefore be thoroughly cleaned previous to use. The most effectual mode of doing so consists in steeping the cress for some minutes in salt water, and then washing well with fresh.

CUCUMBER. See FORCING.

DANDELION (*Taraxacum Dens Leonis*—Syngenesia Polygamia Æqualis, L.; Compositæ, J.; Asteracæ, Lind.)—This well-known plant, which medicinally is of some importance as an anodyne, aperient, and diuretic, is occasionally blanched and eaten as a salad, both in this country and in France; and, as such, it is much esteemed by many persons in both countries.

It should be sown in spring, in a rather moist soil, previously well dug; or roots may be planted. In the following spring, as soon as the plants begin to push above ground, they may be covered with a layer of sand 3 or 4 inches in thickness, or flower-pots may be placed over them; but blanching by means of sand is preferable. When the leaves begin to make their appearance above the sand, a portion of the plants may be cut over by the ground, and by casting the sand which covered them over the uncut portion, the latter will be covered to a greater depth at each cutting, and will consequently come in for use in succession. It is hardly necessary to observe that the plants should not be allowed to scatter their seeds in summer.

DILL (*Anethum graveolens*, L.—Pentandria Digynia, L.; Umbelliferæ, D. C.; Apiacæ, Lind.) is a biennial plant, a native of Spain and Portugal. The leaves are used in soups, sauces, and pickles. It should be sown, where it is to remain, in autumn when the seed is ripe, in the end of February, or in March or

April, in shallow drills 9 inches apart. When the young plants are 2 or 3 inches high, they should be thinned out to about 8 inches asunder in the row. If allowed to seed it will sow itself; but when this is not desirable the flower-stalks should be cut off a little before the seed is completely ripe, and dried.

DIOSCOREA BATATAS, Decaisne, (Diœcia Hexandria, L.; Dioscoreæ, D. C.; Dioscoreaceæ, Lind.) is a perennial plant, a native of China, and introduced from France in 1854. This new introduction is supposed to be capable of becoming a substitute for the potato, or even a formidable rival to that esculent. The following extracts are from an excellent memoir by M. Decaisne, which appeared in the *Bon Jardinier* for 1855:—

“After the unsuccessful attempts,” says M. Decaisne, “which have been made during the last seven or eight years to obtain a substitute for the potato, there appears to be a timidity on the part of most persons in recommending to the public any plant to fill its place. This, however, I do not pretend to do, for, on the one hand, I do not believe that the potato is for ever lost to agriculture; and, on the other hand, I look upon it as difficult, if not impossible to replace it with another plant, capable of yielding an equal amount of nutriment, and at the same time accommodating itself so well to our climate and agriculture. But after having made these reservations, I have still reason to believe that the agriculturist will give a favourable reception to the plant which is the subject of this article, and that he will derive sufficient advantages from it to place it not on an equality with the potato, but still to assign it a distinguished, though secondary, place in his rotations.

“This plant is a Chinese yam, sent to the museum, four years ago, by M. de Montigny, French consul at Shanghai.

“In vain have I sought to attach it by its botanical characters to any of the numerous species of yams mentioned by authors as being cultivated in various countries. Mr. Fortune does not speak of it in the account of his travels in China. It is certainly different from, though closely allied to *Dioscorea japonica* and *D. oppositifolia*, described by Thunberg and Rumph, under the names of *Ubiu anguinum* and *U. draconum*, species or varieties which it would also be very desirable to introduce into the south of Europe and Algeria. I have, therefore, considered the plant as new

to botanists, and have called it *Dioscorea Batatas*.

“*Dioscorea Batatas*, like the black bryony, *Tamus communis*, of our own country, belongs to the small family of Dioscoreæ, and in outward appearance it greatly resembles that plant. Its stems are annual; but its roots, or more properly speaking, its rhizomes, are perennial, full of starch and somewhat milky, true subterranean stems, which, instead of extending horizontally above or beneath the surface of the ground, strike perpendicularly downwards to the depth of a yard, and sometimes more, according to the looseness of the soil. The stems, properly so called, grow to the length of from 3 to 6 feet, are cylindrical, as thick as a large quill, turning from right to left, violet, specked with white. When left to themselves they spread over the ground and readily take root. The leaves are generally opposite, a remarkable character in a monocotyledonous plant, they are triangularly heart-shaped, acuminate at the upper part, and have seven or nine principal nervures converging towards the apex, with a fine net-work of small veins between. Their length and breadth are nearly equal, varying from 1 to 2 inches; their surface is smooth, shining, and dark green; the petioles, which are generally half the length of the leaves, are deeply channelled on the upper side, and frequently tinged with violet at the origin of the blade. The flowers are diœcious, disposed in small racemes at the axils of the leaves; the males, which are the only ones we have seen, are very small, of a pale yellow or livid hue, and scarcely $\frac{1}{2}$ th of an inch in diameter; they are composed of six leaflets, the three outer ones roundish, the three inner ones shorter and roundish oval; the stamens, six in number, are likewise extremely small, but well formed; the anthers are oval, and supported by short separate filaments, which are in a group in the centre of the flower.

“The rhizomes, or roots, as they are commonly called, vary in length and thickness with the vigour of the plants, and, probably, also with the soil, by the looseness or adhesiveness, as well as the depth of which, their form and mode of development must certainly be affected. They may, in general, be compared to a club, the blunt end of which is as big as the fist, but which gradually tapers upwards till it is no thicker than the finger. The skin is fawn-coloured, or of the same colour as

coffee and milk, and is covered with numerous rootlets. Under the skin is a white, opaline, very friable cellular tissue, full of starch, and somewhat milky. In cooking, this tissue softens and dries till it becomes in taste so nearly the same as the potato, that a person not informed of the difference, might easily mistake the one for the other.

"Each plant may produce several of these rhizomes, though usually there is only one. We have had some weighing as much as 2 lbs. 15¼ oz., but in general, their average weight may be estimated at from 10½ to 14 oz., and their length is said to be sometimes more than a yard, but we have seen none of that length. The average circumference at the thickest part is about 6 inches.

"Speaking from my own experience, and that of the persons whom I have invited to taste this yam, I think there can be no serious objection to its being employed as an article of food; but it remains to be seen whether a root which buries itself so deeply in the ground, and which would be difficult to take up, would suit our agriculture.

"On this point, I will for the present confine myself to remarking, that in China, this peculiarity does not appear to be an obstacle, for the *Dioscorea Batatas* is extensively cultivated in that empire, as will be seen by the following notes by M. de Montigny, and some extracts from works on Chinese husbandry, which I owe to the kindness of M. Stanislas Julien.

"M. de Montigny says—'The *Sain-In* is of great importance in China. Its produce is large, and the country people use it as food to as great an extent as the potato is used in the north of Europe. For propagating the plant, the smallest roots (rhizomes) are preserved through the winter in a pit, well lined with straw and covered over with earth. In spring, they are taken out of the pit and laid down on their sides, and pretty close together in furrows in well-dug ground. They soon sprout and produce trailing stems, which are made into cuttings at the expiry of a month, or as soon as they are 6 feet in length. The cuttings are planted in the following manner:—The ground having been prepared, ridges are thrown up by means of the plough or spade, along the top of the ridge very shallow furrows are formed, and in these, pieces of the stems or shoots are laid down and covered, all but the leaves, with a thin layer of earth. If

rain follow this operation, the cuttings strike immediately; if, on the contrary, the weather be dry, water must be given till they begin to push. After the lapse of a fortnight or three weeks, the tubers begin to form, and fresh stems appear; the latter must be removed from time to time, otherwise they would take root on all sides, and prevent the tubers already formed from attaining their proper size.'

"Many details, which it would be desirable to have, are not given in this note; for instance, the distance between the ridges, the depth of the furrows, and mode of taking up the crops, are not mentioned.

"The following are the extracts from the treatises on Chinese agriculture which seem to relate to the plant of which we are speaking, but I suspect that some of them refer to other yams cultivated along with it; thus the details immediately following, appear to have reference to a species with roundish rhizomes, as big as a large apple:—

"The Chinese yam, according to the *Pen-Tsao-Kang-Mo* (book xxvii. fol. 33), is called in Chinese *Chou-Yu*; it is also named *Tchou-Yu*, *Tou-Tchou*, *Chan-Tchou*, *Chan-Yo*, *Chan-Yu*, names the literal meaning of which is *mountain arum*. It is universally cultivated. That of Nankin is very large and of excellent flavour; that from the Chou country is still better; but for medicinal purposes the *Chou-Yu* of Hoaï-King is considered the best. It pushes in spring, and spreads over the ground; its stem is violet; its leaves are green and three-lobed, they resemble those of the *Pe-Kien-Niéou*, only they are thicker and more glossy. This plant flowers in the fifth and sixth months; its flowers are small, disposed in spikes, and of a pale red colour; they resemble those of the jujube tree.

"In autumn, the fruits appear between the leaves; they are of a yellowish green, ripen in the eighth month, and drop of their own accord. The lower extremity of the roots is covered with a thin skin; they are sometimes large, sometimes small, and the flesh is white. They are boiled in water; they are mild in taste, and laxative; the varieties having a blackish blue flesh are not held in much esteem, those with white flesh being greatly preferred.

"In the south of China there is another species or variety of *Chou-Yu*, which grows on the mountains. Its roots are as thick as the finger, and the tissue is very compact. They are scraped, crushed by a millstone, and made

into forcemeat-balls, which, when boiled, have a delicious taste. Those who partake of them acquire strength and vigour.

"In the province of Fo-Kien, there is another species of yam, the root of which resembles that of the *Kiang-Yu*, but the skin is violet. The largest roots, having been peeled and cut into thin slices, are boiled; they are excellent, but of a colder nature than those from the north of China, where the plant bears the name of *Tchou*. This food is mild, sedative, and in no way injurious. It is much used in the local medicine, but for medicinal purposes the roots of the plant growing in its wild state are preferred.

"The following details respecting the *Chan-Yu*, which is probably the same species as *Dioscorea Batatas*, are given in the Chinese work entitled *Nong-Sang-Tsi-Yao* :—

"The species (variety) having the roots white (as rice) is chosen, and the seeds are gathered. Three or five trenches, each 10 feet long, 3 feet broad, and 5 feet deep, are formed, and the bottom is covered with bricks, well cemented together. The sides and ends of the trenches are also lined with bricks, to prevent the roots of the adjoining plants from penetrating into the interior.

"The trenches having been completed, and filled with earth mixed with dung, three shallow drills are formed in which the seed is sown. When the plants begin to push, they are supported with stakes.

"In a year the roots will become extremely large, and a man may live upon the produce of a single trench for a whole year. If the plant is to be propagated by means of the roots, they must be cut into pieces a foot in length and planted singly.

"In the book entitled *Ti-li-King* (that is to say, the Book of the Products of the Earth) we find the following passage, which relates to species of *Dioscorea*, and most probably to the one which is the subject of this article :—

"When the root is very long it is cut into pieces 2 inches in length for planting. In the same year seeds are produced, which, after they are gathered, are buried in the ground to preserve them. In spring, they are taken out of the ground and sown. In the cultivation of this plant, night-soil must never be made use of—stable-dung (that of the ox or cow) mixed with earth, should alone be employed. Thus treated, the plant will push vigorously, and soon yield its products."

"Lastly, the following, which relates to the cultivation of the *Chan-Yo* (syn. of the *Chou-Yu*) occurs in the *Wou-pen-si-Chou* :—

"A little before the period called *Han-chi* (April 4th) a sandy piece of ground is chosen, and in it are formed trenches about 10 feet long, and 2 feet deep. These are filled up with a compost consisting of equal parts of earth and well-decomposed stable-dung. Long and strong roots of the *Chan-Yo*, the surface of which is covered with needles (fibrous roots), are then cut into pieces 3 or 4 inches in length, and the pieces are laid down in the trench so as to overlap each other like the tiles of a roof; they are then covered with 6 inches thick of the same compost as that used to fill up the trenches. If the weather is dry, they are moderately watered. Above all, care should be taken to use no night-soil. When the stems have grown to some size, they are supported by stakes. After the *Choang-kiang* (October 2d) and before the ground is frozen, the largest roots are taken up and preserved in a cellar. In the following spring they are planted as before. That they have not been injured by frost is an important point."

From the above extracts, M. Decaisne concludes that the mode of cultivating the plant might be varied according to the locality, and that nowhere would it be difficult with our improved tools.

"It is certain," continues M. Decaisne, "that none of the plants hitherto proposed as substitutes for the potato can be placed in comparison with the Chinese yam. Every one knows how transient was the favour enjoyed by such novelties as the *Ulluco*, *Psoralea esculenta*, *Apios tuberosa*, *Tropaeolum tuberosum*, &c. The *Ulluco*, in spite of all efforts to reclaim it, has proved to be totally unfit for human food. As for the *Psoralea* and the *Apios*, the necessity of keeping them for several years in the same place in order to obtain a trifling produce of doubtful value, excluded them from all chance of success.

"If a new plant is to have a chance of becoming useful in rural economy, it must fulfil certain conditions; and unless it do so, its cultivation cannot be profitable. In the first place, it must have been domesticated somewhere, and must suit the climate; moreover, it must, in a few months, pass through all the stages of its growth, so as not to interfere with the ordinary and regular course of cropping; and, finally, its produce must have a market

value. If the plant is intended for the food of man, it is also indispensable that it shall not offend the tastes and culinary habits of the inhabitants of the country into which it is to be introduced. To this we may add that most of the old perennial plants of the kitchen garden have been abandoned for annuals, whenever these could be found with similar properties; thus, *Lathyrus tuberosus*, *Sedum Telephium*, and *Cirsium oleraceum*, have been abandoned for potatoes, spinach, &c. Now, the Chinese yam fulfils every one of these conditions: it has been domesticated from time immemorial; it is perfectly hardy in our climate; its root is bulky, rich in nutritive matter, edible raw, easily cooked, either by boiling or roasting, and has no other taste than that of potato starch. It is as much a ready-made bread as the potato, and more so than the batatas or sweet potato."

M. Decaisne, in a second article, gives the following account of the experience gained in 1854:—

"About the middle of April, when danger from frost was considered to be over, some pieces of the roots were planted out in the garden of the Museum of Natural History. Some were taken from the upper and smaller part of the tubers, others from the thicker part. The former were scarcely as thick as the little finger, and averaged $2\frac{3}{4}$ inches in length; the others were much larger, and formed slices or cross sections of a cylinder, each $1\frac{1}{4}$ to $1\frac{1}{2}$ inch thick on the edge. Three tubers, weighing from $10\frac{1}{2}$ to 14 oz., were planted whole, in order to compare their produce with that of the cut sets. The plantation was made in an open border, and on the level, not on ridges, as ought to have been done—a circumstance, however, which in no way affected the growth of the tubers, but only rendered the taking up difficult. The distance between the plants was $19\frac{1}{2}$ inches every way; this was another mistake; for, according to the judicious observations of M. L. Vilmorin, they should have been much wider apart.

"The short time which has elapsed since the introduction of the Chinese yam, prevents me from determining what may be called a good or bad year for it; the future alone will show under what conditions of climate it best succeeds. All that can be said at present is, that in 1854, the growth of the plants was regular, that their long twining stems grew vigorously,

and were thickly covered with leaves; that abundance of flowers were produced in the beginning of August (all our plants are males); and, lastly, that active vegetation ceased, and the leaves gradually acquired a yellowish tinge after the middle of September, thus indicating that the tubers had nearly come to maturity.

"With the exception of some specimens kept apart for other experiments, all the plants were separated into three distinct lots. Two of these lots were staked—one with strong stakes 10 feet or more in height, the other with stakes 6 or 7 feet high. The stems twined round the stakes very regularly, in the same way as scarlet runners, and soon grew beyond them.

"In the third lot the plants were left unsupported, and their stems spread over the ground without taking root, twining amongst each other; these did not nearly attain the length of those which were staked.

"In no case were the plants either earthed up or the ground weeded, for these operations appear to be unnecessary. The tubers were taken up on the 6th of November. The following tables exhibit the results of the different modes of planting and cultivation which were adopted.

"A.—*Tubers planted whole, weighing, on the average, $10\frac{1}{2}$ oz. each.*

"The three tubers planted whole produced very vigorous plants, each of which formed one fresh tuber; two of these were enormous, and quite out of the common run, one weighing, when taken up, about 3 lbs., the other 2 lbs. 9 oz. The third was attacked by the grub of the cockchafer or May-bug (*Melolontha vulgaris*, Fab.), and only yielded pieces; its stems, moreover, withered in August. The tubers which had been planted, were much shrivelled, without, however, being in a state of decay. Notwithstanding the size of the two new tubers obtained, I consider this mode of planting to be objectionable.

"B.—*Plantation made with pieces of the tubers varying in length and thickness.*

"1. Plants with stakes 10 feet high. This lot consisted of sixteen plants, of which one produced two middle-sized tubers, weighing together fully $11\frac{1}{2}$ oz., and which ought to be considered as only forming one. The tubers were weighed carefully three days after taking up, when clean and dry, with the following results:—

No.	Grammes.	No.	Grammes.
1	95	9	175
2	140	10	350
3	390	11	185
4	540	12	105
5	260	13	95
6	330	14	100
7	390	15	100
8	420	16	30

3 k. 705 gr.

[About 8 lbs. $2\frac{1}{2}$ oz., or a mean per tuber of $8\frac{168}{1000}$ oz.]

"2. Plants with stakes from 6 to 7 feet high. These plants, twenty-eight in number, also produced only one tuber each. The weights were:—

No.	Grammes.	No.	Grammes.
1	40	15	550
2	50	16	270
3	55	17	380
4	195	18	370
5	690	19	270
6	550	20	265
7	520	21	220
8	790	22	230
9	540	23	225
10	420	24	355
11	420	25	55
12	440	26	165
13	450	27	210
14	765	28	175

9 k. 655 gr.

[21 lbs. $4\frac{1}{2}$ oz., or a mean weight per tuber of $12\frac{175}{1000}$ oz.]

"3. Plants not staked; their stems spreading over the ground without taking root in it.

"These plants, thirteen in number, gave the following results:—

No.	Grammes.	No.	Grammes.
1	488	8	245
2	475	9	150
3	460	10	140
4	488	11	120
5	400	12	110
6	495	13	55
7	290		

3 k. 916 gr.

[8 lbs. $6\frac{1}{2}$ oz., or $10\frac{625}{1000}$ oz. per tuber.]

"The sum total of the produce of the three lots planted with pieces of tubers, gives 17 k. 286 gr., or 38 lbs. $1\frac{3}{4}$ oz., as the produce of fifty-seven plants, which is rather more than $10\frac{1}{2}$ oz. for the average weight of each tuber.

"In this calculation the space on which the plants grew is not taken into account, for it would not have led to any useful inference, because, as has been already stated, the plants were too far apart. But when we take into consideration the tap-rooted nature of the plant, the shortness and fineness of the lateral roots, which are not more than 3 or $3\frac{1}{2}$ inches long; and, moreover, the large development of

the leaves, which indicates that the plant lives principally on the elements contained in the atmosphere, we arrive at the conclusion, that at the distance of 10 or even 8 inches apart every way, the plant would have sufficient space for its proper growth. There would thus be from 16 to 25 plants in a square mètre (rather more than $10\frac{3}{4}$ square feet). Assuming that the twenty plants produce, on an average, each $10\frac{1}{2}$ oz. of tubers, we have about $13\frac{1}{4}$ lbs. per square mètre, or about 23 tons 17 cwts. of tubers per acre. This is double the average weight of potatoes produced in France on the same space of ground.

"So large a produce is, I admit, nothing but an assumption, and calculated for the most favourable conditions of soil and temperature in the climate of Paris. It is also made upon the supposition that the whole of the ground is occupied. But although the computation may be too high, and notwithstanding that the Chinese yam costs more to plant than the potato, I have every reason to believe that the produce of the *Dioscorea Batatas* will exceed that of the potato, and that the greater difficulty in taking up will be compensated by the larger amount of nourishment which the tubers contain. It is in order to diminish the labour of taking up that I recommend this yam to be planted on ridges, following, as much as possible, the Chinese method previously described. The following are the grounds upon which this opinion is founded:—

"The tubers of the Chinese yam were, in general, from $13\frac{3}{4}$ to $19\frac{1}{2}$ inches long, seldom more. The upper third is small, perhaps as thick as the little finger; this, in my opinion, is the only part that should be kept for planting; and, in most cases, three or four slices, large enough to form vigorous plants, may be obtained; the rest of the root may be eaten. It is, therefore, important that the entire root should be taken up, especially as its lower extremity is always the largest part, and that which is richest in starch. Now, by laying out the ground in ridges or narrow beds, 10 or 12 inches high, the operator has only to dig a spade's depth into the furrow, at the side of the ridge or bed, to reach the lower end of the root; and by turning over the ridges so as to level the ground at the same time, the crop may be taken up without difficulty. It is evident, indeed, from what has been stated, that if the sets are planted sufficiently close, the labour of taking up will not be greater

than that required for the same weight of potatoes. I cannot at present settle the breadth of the beds, or the distance from ridge to ridge; but it seems to me that a space of 20 inches, planted with three rows of yams, would answer very well. The furrow or alley between the beds should not be more than a foot wide—just enough for a man to work in it. I may add that the plants should not be staked, because their stems, if allowed to spread over the ground, preserve its moisture, and also because they may be made to root by a sort of layering, similar to that practised by the Chinese, who by that means propagate the plant with great facility.

"I have no hesitation in stating, that I consider the Chinese yam to be superior in quality to the potato. Although no comparative analyses of the two have been made, I believe the Chinese yam to be much the richer in nutritive principles. Its roots are white as snow in the interior; they contain neither visible fibres nor tough woody matter; and, when boiled, they become so soft that a slight pressure converts them into a paste, which can only be compared to that of the finest wheaten flour. Cooked by steam or roasted they look and taste like the best potatoes. They have one advantage which every one will appreciate, namely, the short space of time required for cooking. Two pieces of tubers, of the size of a hen's egg, one the Chinese yam, the other the sweet potato of the white variety, were put into boiling water, at the same time as a Dutch potato of the same size; the first and second were done in ten minutes, the third in twenty minutes. In respect to the facility with which it is cooked, the Chinese yam is, therefore, as much superior to the potato as that esculent is to farinaceous grains; and it must not be forgotten that this quality has greatly contributed to the popularity of the potato, as it requires but little fuel to cook it; an advantage which, as we have seen, is possessed in a still greater degree by the Chinese yam.

"There is yet another point to which it is necessary to draw attention. It is the facility with which the roots may be preserved for a whole year, and even longer. The potato sprouts in spring when kept in cellars. The Chinese yam is wholly free from this disadvantage; it is not affected either by heat or cold, perhaps not even by moisture. Left in the ground its tubers remain without being in-

jured, as I proved by leaving a root in the ground, where it remained throughout the severe winter of 1853-4, and pushed again at the return of spring. It is, therefore, a hardy plant in the widest acceptance of the term.

"The Chinese yam has been cultivated at Algiers with equal success; and M. Hardy, speaking of its quality, says:—'The tubers contain a slightly viscous, but tasteless juice, which entirely disappears in the cooking. Cooked by steam, or roasted, they taste like the best potatoes. The flesh is white and floury.'

"Many of the *Dioscoreæ* have the power of propagating themselves by bulbs, which drop off from the stem as soon as they arrive at maturity. The *Dioscorea Batatas* is one of these; at the axils of its leaves small round bulbs, which are used in China for the propagation of the plant, are very frequently formed. It is from these that the useful rhizome of the plant originates, or, to speak more correctly, the rhizome is merely a continuation of these bulbs in a downward direction."

M. Vilmorin says (*Bon Jardinier*, 1855, p. 489), that the mode of cultivation which has hitherto succeeded best with him, consists in taking moderately large pieces of the tubers, and preferably the crowns of such as are beginning to vegetate, and planting them in April in small pots placed on a hot-bed. When all danger of frost is over, the young plants are planted out in light rich soil. The roots having a tendency to strike perpendicularly downwards are not injured by the twisting which they experience in the pot. He even thinks that the plant might be successfully grown in large pots plunged into the ground, especially where the depth and looseness of the soil would induce the roots to strike down to the depth of a yard or more. Judging from its growth being arrested in dry weather, the plant appears to like moisture. From the small proportion which the foliage bears to the bulk of the root, he imagines that the plants may be planted pretty close together—8 or 10 plants to a square mètre (about 10 $\frac{3}{4}$ square feet). At this distance, plants which were *watered* produced roots weighing, on the average, nearly 18 oz. each. When not staked the stems spread over the ground, and get entangled with each other. Short straight stakes appear to be necessary, in order to allow of the ground being cleaned, for the small amount of foliage which the *Dioscorea* produces does not

protect it from the intrusion of weeds. With respect to the comparative amount of produce yielded by plants staked and those not staked, in a first experiment there was a trifling advantage in favour of the latter.

The roots are taken up as late in the season as possible, for the chief increase in their size takes place in autumn. The upper and slender part of the root may be reserved for propagation, and the lower or fleshy portion may be made use of after having been allowed to dry for a few days.

The above mode of cultivation applies to plants already in bearing; and, by adopting it, a crop is produced the same year. If, however, it be desirable to propagate the plant rapidly, the easiest way is to make cuttings of the stems. This is done in the following manner, about the month of July:—The stems are cut into as many pieces as there are leaves, and these small cuttings are planted close together, in peat or light sandy soil, and covered with a bell-glass. The piece of the stem should only be put into the ground to the depth of a quarter of an inch, and the leaf, unless altogether out of proportion to the rest of the cutting, should be left entire. At the end of five or six weeks the cuttings are rooted, and bear a little bulb, about the size of a small nut, at the axil of each leaf. These increase but little in size during the rest of the season: they are allowed to ripen by ceasing to give water; and, by the following spring, they furnish plants as strong as those from the pieces of the roots. In this way each plant may be made to produce several hundred others. Cuttings may also be struck, without the aid of bell-glasses, in a somewhat shady part of the garden. In this case, instead of cutting the stems into pieces, it is better to lay them horizontally in the ground, so that the leaves may lie flat upon the surface, and to cover slightly with earth. The surface should be kept constantly moist by frequently watering through a fine rose.

From experiments made in the garden of the Horticultural Society, in 1856, the *Dioscorea* is found to be perfectly hardy in this country. It was grown from small axil tubers, about the size of marrow pease; from small roots; from large-sized whole roots; and from cut roots. All these were planted in the open ground, in the beginning of March, and the produce was taken up in the end of November. The greatest produce was obtained from whole

roots; but sets from roots cut in sections of about an inch, or an inch and a half in length, planted 3 inches deep, gave a fair average. Mr. Sibbon, of Trent Park, East Barnet, also cultivated it very successfully, by employing cuttings of roots raised in the previous year from small stem or axil tubers. The cuttings of the roots were somewhat forwarded in pots under glass, and planted out a foot apart, in June, in a raised bed of half-decayed leaves, covered over with common garden mould. The crop was taken up in November, and the weight from 24 square yards was $42\frac{1}{2}$ lbs. The largest tuber was 39 inches long, and 7 inches in circumference, and weighed $1\frac{1}{2}$ lb.

Although the *Dioscorea* will force its root into compact loam, yet there can be no doubt that the ground should be trenched at least 3 feet deep; and that by forwarding the plants in spring, so as to have a longer season of growth, a larger produce will be obtained. In short, the tubers can only be formed by the action of light on the leaves; and it is evident that the greater the amount of foliage, and that of the light to which it is exposed, the larger the tubers will be. Means should, therefore, be taken to grow the plant early, so as to have a considerable extent of foliage to be acted upon, whilst the days are long.

EGG PLANT. See FORCING.

ELECAMPANE (*Inula Helenium*, L.—Synonymia Polygamia Superflua, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a perennial plant, a native of Britain, where it is found growing in moist pastures. It is cultivated for its root, which is considered to be tonic, diuretic, and diaphoretic. It may be propagated by dividing the roots, leaving an eye or bud on each piece. These divisions should be planted a foot apart, in rows 15 inches asunder, in newly dug ground, rather moist than otherwise. It may also be raised from seed sown in September, the plants being thinned out in the following year to the above distances; the former is the mode generally adopted. Roots two years old are considered to be the best and most tender, consequently a fresh plantation must be made every year, if an annual supply of roots of that age be required.

ENDIVE (*Cichorium Endivia*, L.—Synonymia Polygamia Æqualis, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a hardy annual, said to be a native of the East Indies. The varieties are numerous, and are divided into two classes:—I. CURLED-LEAVED (*C. E. crispa*),

chicorées of the French, which includes those with narrow leaves, more or less divided, and much curled; and, II. BATAVIAN, or BROAD-LEAVED (*C. E. latifolia*), *scaroles* of the French, which includes all with broad leaves not curled. These divisions comprise the following varieties:—

I.—Curled Endives.

1. SMALL GREEN CURLED—syn. Green Curled, Chicorée frisée, Chicorée de Meaux, Chicorée Endive.—Leaves much cut and curled, from 6 to 7 inches long, lying flat on the ground; heart-leaves full and close. It is slow in hearting, and when sown early is apt to run. It was formerly almost the only sort cultivated in France, but for early crops the succeeding sort is now preferred; it is, however, still esteemed for the later sowings.

2. FRENCH SMALL GREEN CURLED—syn. Fine Curled, Chicorée frisée fine d'Italie, Chicorée d'été, Chicorée fine d'été.—A small, very dwarf sort; hearts closer and sooner than the preceding. Excellent for early use. It cannot be tied up, but blanches readily when covered.

3. LARGE GREEN CURLED—syn. Green Curled, Cut Yellow Winter Endive of the Germans.—Leaves longer, and rather more upright than those of the Small Green Curled. It ties up well to blanch, is hardy, and not subject to rot.

4. ITALIAN GREEN CURLED—syn. Indivia Riccia.—Leaves narrow, divided to the very mid-rib, segments also much cut and curled; whole plant dark green. Ties up well.

5. DUTCH GREEN CURLED—syn. Large Green Curled of the Dutch.—Scarcely worth distinguishing from the Large Green Curled; it differs in the outer leaves being broader, deeper cut, and not so much curled. It is hardy and blanches well.

6. LONG ITALIAN GREEN CURLED—syn. Indivia longa.—Resembles the Italian Green Curled, the leaves being deeply cut, but their segments are not disposed to curl; and it is on the whole inferior.

7. WHITE CURLED—syn. White Endive, Chicorée toujours blanche, Chicorée blanche.—Leaves 7 or 8 inches long, with a very open heart, growing flat on the ground. The whole plant is of a pale yellowish colour. It is best when cut very young for salads, as the French use it. When full-grown, the leaves are tough,

very bitter, and do not form a good heart, it should therefore only be used young.

8. STAG-HORN ENDIVE—syn. Corne de cerf, Rouennaise.—Leaves deep green, finely cut, but not much curled; heart full, yellow, and tender. Preferred at Rouen, but not so much esteemed at Paris, where they find it more apt to run to seed, and to decay sooner than No. 2.

9. MOSS ENDIVE—syn. Triple Curled Moss, Extra Curled Moss, Chicorée mousse.—A new and very finely curled sort allied to the preceding.

10. PICPUS CURLED—syn. Chicorée de Picpus.—According to M. Vilmorin, this is a fine sort, intermediate between the Stag-horn endive and the Small Green Curled, being closer and fuller than the latter.

II.—Batavian, or Broad-leaved Endive.

11. BROAD-LEAVED BATAVIAN—syn. Broad-leaved Endive, Double Yellow, Common Yellow of the Dutch.—Leaves long and broad, the edges somewhat ragged, the outer ones very upright. The sort of Batavian endive most commonly cultivated. It requires to be tied up for blanching.

12. CURLED BATAVIAN—syn. Fine Curled Batavian, Yellow Curled Batavian.—Leaves not so large as those of the preceding, curled at the edges, and growing flat on the ground. The heart forms of itself, is small, and lies close to the ground.

13. SMALL BATAVIAN—syn. Scarole petite, Scarole courte, Scarole ronde.—Leaves pale green, broad, of moderate length, slightly ragged at the edges; inner leaves hooded at the top, naturally forming a good heart, blanching with little trouble. It is mild and sweet, compared with many others.

14. LARGE BATAVIAN—syn. Scarole grande, Scarole de Hollande.—This can only be considered a large variety of the preceding, scarcely hearting so well; nevertheless it forms a large heart, well blanched, and of good flavour. Does not require to be tied up.

15. LETTUCE-LEAVED BATAVIAN—syn. White Batavian, New Batavian, Scarole blonde, Scarole à feuille de laitue.—Leaves large, obtuse, ragged at the edges, of a pale colour even when young. They require to be tied up for blanching. This sort should only be cultivated for early use, as it is tender as regards damp and severe weather.

16. WHITE-FLOWERED BATAVIAN—syn. *Sca-rolé à fleur blanche*.—A new and excellent variety, which blanches remarkably white and tender. Flowers white. This sort is highly deserving of cultivation.

The best sorts for general cultivation are Nos. 2, 3, 5, 11, 13, 16.

A light rich soil, with a dry subsoil, is the best adapted for the growth of endive. A situation not shaded by trees should also be selected for this crop.

A small sowing to be used young may be made in the beginning of May, but the plants produced will be very liable to run. In the end of May another small sowing may be made; and about the middle of June the first main crop may be sown. The principal crops for winter use require to be sown in the middle and end of July. Lastly, a small quantity to come in late may be sown towards the middle of August.

The seed should be sown thinly, on a bed of rich earth raked fine, in shallow drills 4 inches apart, covering lightly with fine soil. In dry weather, the seed-beds should be watered through a fine rose till the plants make their appearance. The plants, as they advance in growth, should be thinned out to 3 or 4 inches apart in the rows; and in dry weather frequent waterings should be given in order to promote a rapid growth. When the plants have made four leaves, and are sufficiently strong for transplanting, they should be carefully taken up and replanted where they are to remain, the ground having been previously deeply dug. Plants of the curled-leaved varieties may be planted 1 foot apart each way; but for the Batavian endives, which generally require more room, 15 inches by 12 inches may be allowed. Water should be given at planting, and till the plants are established; subsequently, in dry weather, watering should be persevered in, with the view of encouraging the production of tender and succulent leaves.

Instead of sowing in seed-beds and transplanting, some sow at once where the plants are to remain, and thin out to the proper distances. This answers well for the early crops, or such as have not to be planted on sloping banks, or in frames in winter; but when the contrary is the case, sowing in seed-beds, and planting out, is a better plan, as the production of roots is encouraged by the latter operation; and, consequently, the plants can be

finally transplanted with a better chance of success.

About three months after sowing, or as soon as the plants are nearly full-grown, blanching may be commenced. This operation can be performed in various ways. Commonly the leaves are gathered together, and tied up near the top with matting, and about a week afterwards they are again tied, this time round the middle. Tying up should only be performed when the leaves are perfectly free from moisture; afterwards, if water should be necessary, it should only be given at the root of the plant. Blanching is also effected by placing inverted flower-pots over the plants, and covering the hole in the bottom with a piece of slate or tile; by means of sea-kale pots; laying a slate, or, preferably, a flat tile, over the plants; by covering with sand or coal ashes; or by placing boards on each side of the row, leaning their upper edges against each other, so as to form a roof, and preventing the light from getting in at the ends. A mat laid over the plants also answers tolerably well for the flat-growing kinds. The best methods, however, are tying up, or using a blanching-pot.

According to Captain Churchill, endive is blanched in the following manner in the province of Guipuscoa, in the north of Spain:—

“The blanching is generally performed by pressing the heart of the plant gently down, on which a fragment of tile is laid; over this a light covering of earth is sifted. The fringed edges of the exterior leaves are carefully freed from earth, and exposed to light; having small bits of tile laid over that portion of the soil from whence they protrude, to render the blanching perfect, and produce what the gardeners particularly pride themselves on, namely, a plant of endive white all over, excepting the edges of the outer leaves, which should show about 2 inches of green. The plants thus cultivated are slightly bitter, crisp, and juicy.”—(*Gardeners' Chronicle*, 1842, p. 452.)

The time occupied in blanching varies from ten days to three weeks—a longer period being required for completing the process in winter than in summer, when growth is more rapid. A number of plants, sufficient to afford a supply for a week, should be set to blanch at one time, and by doing the same every week, a constant succession of blanched endive will be secured.

Various modes of protecting endive during the winter are adopted. The market gardeners near London form sloping banks facing the south, and sheltered from the north. On these they plant the endive in November, at 6 or 8 inches apart, and protect it with litter in severe weather, but leave it uncovered at all other times. A supply during winter may, however, be more certainly secured by taking up the late sown crops before frost, and re-planting in dry earth or sand, in a frame or shed, or by placing a frame over them without taking up.

To save Seed.—Only the finest specimens of plants, true to their varieties, should be selected for bearing seed, otherwise a degeneration is likely to be the result. Seed may be saved either from autumn-sown plants protected through the winter, and planted out in a warm sheltered situation in March, or from plants raised from seed sown early in spring. The flower-stems should be supported by stakes or strings, to prevent injury from the wind, and the seed should be gathered as it successively ripens. After having been spread upon a cloth till it is dry, it may be rubbed out and stored. It remains good for five or six years; plants raised from old seed are not so apt to run as those from seed newly saved.

FENNEL (*Anethum Feniculum*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceae, Lind.) is a perennial aromatic plant, indigenous or naturalized in this country. The leaves are used in fish sauces, and for garnishing; the stalks are eaten in salads; and the seeds are employed in confectionary, and for flavouring liquors.

There are two varieties cultivated:—

1. COMMON FENNEL.
2. FINOCHIO.

The *common* sort may be propagated by sowing the seed in February, March, or April, on a light warm soil. It may be sown in shallow drills 15 inches apart, thinning out the young plants when 2 or 3 inches high to 1 foot apart; or the seed may be sown in a bed, and the seedlings planted out when 3 or 4 inches in height to the above distances apart. It may also be propagated by parting the roots in March. With the ordinary culture of keeping the ground free of weeds, and stirring it occasionally, a plantation will last several years. If seed is not to be saved, the plants should be topped, with the view of

encouraging a growth of young and tender leaves, and to prevent the production of seed, which, if allowed to ripen, would scatter, and seedlings would spring up in all directions.

Finochio is the name given to another variety, or perhaps species of fennel, much cultivated in Italy for its stalks, which swell out to a considerable thickness just above the ground, and which are blanched like celery.

We translate from the *Bon Jardinier* the following details respecting its nature, and the manner in which it is used in Italy:—

“Large quantities are consumed in Italy; it is eaten raw, with pepper and salt, generally without any other seasoning; it is excellent for garnishing ragouts, whether made of fowl or meat; also when eaten with white sauce, gravy, or macaroni. When used in the three last-mentioned ways, it is first boiled.

“At Naples, in the Roman States, and at Venice, this fennel is so generally used, that one cannot pass through a town or village without meeting with it; and every table is served with it from January till June.

“The plant has a small root, and arising from it are leaf-stalks like those of celery, but which form a rounder and shorter swelling; this part is very tender and savoury, sweeter than celery, and differing from it so much in taste, as to form a change to those only accustomed to that vegetable. A horizontal section of the swelling forms an oval 4 or 5 inches long, and 2 or 3 inches wide.

Finochio requires a light rich soil, and should be sown in drills 1 foot apart, thinning out, when the young plants are well established, to 8 inches asunder in the row; or it may be sown broadcast, and transplanted to these distances. The ground should be stirred and kept free from weeds, and the plants should be frequently watered, in order that they may grow rapidly and swell their stems, which should be earthed up about three weeks before they are to be used.

A sowing should be made about the middle or end of March, according to the season; monthly from that time till the end of July or beginning of August, if a constant succession is required. The plants from the first sowing will be fit for use in July, and the others will come in for use in succession till December. At the approach of frost, the plants should be protected with fern or litter.

GARLIC (*Allium sativum*, L.—Hexandria Monogynia, L.; Liliaceae, J.; Liliaceae, Lind.)

is a hardy perennial, a native of Sicily and the south of France. It is cultivated for the bulbs, which are used in soups, stews, and other dishes; but not so much in Britain as in Italy, Spain, Germany, and the south of France—its strong flavour, and the offensive smell which it communicates to the breath, causing it to be sparingly used in our cookery.

Garlic succeeds best in a light, rich, and rather dry soil, and a warm situation. It is propagated by separating the cloves of the bulbs and planting them in February or March, 6 inches apart, in shallow drills 1 foot asunder, and covering with earth to the depth of about 2 inches.

A small quantity may also be planted in the end of October or beginning of November, to come in earlier than the spring planting. All the culture necessary is confined to keeping the ground free of weeds. When the leaves turn yellow, the plants may be taken up, and having been dried in the sun, they should be tied up in bunches by the stalks, and hung up in a dry airy room for use. Some bulbs from the autumn planting may be taken up in May or June, for immediate use.

GOURD (*Cucurbita*, L.—*Monœcia* Monadelphia, L.; *Cucurbitaceæ*, D. C.; *Cucurbitaceæ*, Lind.)—The species and varieties of gourd are very numerous. They are tender or half hardy annuals, natives of the warm parts of both hemispheres, and particularly India. They are hardier than their allied genera, the cucumber and melon, and succeed very well in the open ground, in ordinary summers, in the southern parts of Britain. The varieties cross with each other very readily, so that it is difficult to keep any one distinct, if other sorts are growing in the neighbourhood, and flowering at the same time.

The following are some of the sorts best deserving of cultivation:—

1. **LARGE YELLOW GOURD** (*Cucurbita Pepo*, L.)—syn. Mammoth Pumpkin, American Gourd; Potiron jaune of the French.—This is the largest-fruited variety known. In a very rich compost above a large quantity of manure, and under favourable conditions of climate, it grows to an enormous size; fruit weighing 120 lbs. is by no means uncommon. In America, it has weighed 226 lbs.; and at Sutcombe, in Devonshire, one weighing 245 lbs. was produced. This, we believe, is the heaviest fruit on record. The leaves are very large, and the stems thick, running along the ground to

the distance of 20 or 30 feet, if not stopped, and readily striking root at the joints. The fruit is round or oblate, sometimes flattened on the under side, owing to its great weight, sometimes obtusely ribbed, yellowish, or pale buff, frequently covered to a considerable extent with a gray netting. Flesh very deep yellow. It is only used in a full-grown or ripe state, in which it will keep for several months, and even during the winter, if preserved in a dry airy place, where it may be suspended in a strong net. The flesh is used in soups and stews, mashed like potatoes, or baked in pies.

HARRISON'S PUMPKIN is a very productive variety of the preceding, according to Kenrick, who states that it has produced upwards of 50,000 lbs. per acre.

2. **VEGETABLE MARROW**—syn. Succade Gourd, Courge à la moëlle of the French.—Fruit about 9 inches long, and of an elliptic shape; but it is sometimes grown to twice that length, and of an oblong form. Surface slightly uneven, by irregular longitudinal obtuse ribs, which terminate in a projecting apex at the extremity of the fruit. When mature, it is of a uniform pale yellow, or straw colour; the skin, or shell, is very hard when the fruit is perfectly ripened. Flesh white, tender, and succulent, even till the seeds are ripe. It may be used in every stage of its growth. Some prefer it when the flower is still at the extremity of the fruit; others like it older. When well ripened, it will keep well throughout the winter, if stored in a perfectly dry place, out of the reach of frost, and not exposed to great changes of temperature. To have vegetable marrows large and fine for winter, the young fruit should be regularly taken off for use, and when the plant has acquired strength, a moderate quantity ought to be allowed to set for maturity; sufficient for this purpose being reserved, the young fruit that may be subsequently formed should be removed for use in a very young state. The vines or shoots may be allowed to run along the surface of the ground, directing them towards the south; or they may be trained against a wall, if on such there be any vacancy; against palings, or on trellises.

3. **ITALIAN VEGETABLE MARROW**—syn. Courge d'Italie, Courge Coucourzelle.—This forms a dwarf bush with short reclining stems and upright leaves, which are deeply five-lobed. The fruits are used when the flowers are about to drop from their ends; they are then from

4 to 5 inches long, and $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter. When ripe, the fruit is from 15 to 18 inches in length, and about 6 inches in diameter. It is of a pale yellow, striped with green. It should, however, be used in the young green state, for when mature, it is not so good as many of the other gourds. It bears very abundantly, and as it does not run, may be grown in smaller compass than the true vegetable marrow.

4. EGG-SHAPED GOURD—syn. Reeves' Gourd.—Fruit large, weighing from 15 to 20 lbs.; but in rich, highly-manured soil, and with only a few on each plant, it may be grown to upwards of 50 lbs. weight; it is short, ovate, sometimes tapering abruptly. Skin or shell hard, of a reddish colour. Flesh firm, red, excellent in a ripe state cooked as a vegetable, or in any other way in which gourds are prepared. The stems run to a very great length, and bear all along most abundantly. Altogether it is a sort highly deserving of cultivation. It was brought into notice by the late John Reeves, Esq., who has contributed to the horticulture of this country many valuable plants from China, where he resided many years, and from other parts.

5. CROOK-NECK—syn. Early Bush, Summer Crook-neck, Cource crochue.—Obtained from America, where it is much cultivated, and esteemed the best sort for summer. It is a bush variety, very early and productive. Fruit small, crooked-necked, with numerous warty excrescences on the surface; colour bright yellow; shell very hard when ripe. As it does not run, it may be planted 3 feet apart.

6. FALL, OR WINTER CROOK-NECK.—The kind most generally cultivated in New England for autumn and winter use. Necks long, curved, and solid, of a pale yellow; but the deeper the colour the better. An abundant bearer, excellent for pies. Being a runner, it should be planted 6 feet apart.

CANADA CROOK-NECK.—This is also a runner, and is a small variety of the preceding, to which it is preferred by some. Kenrick says (*American Orchardist*, 1844, p. 370), "The Canada Crook-neck is, without doubt, far superior to any and all others for the late or main crop. It is fine-grained, mealy, and of a sweet excellent flavour. By being kept in a dry and suitable temperature [not below 38°] the fruit may be preserved till the following summer."

7. GREEN-STRIPED BERGEN.—A bush va-

riety of strong growth, requiring to be planted 4 feet apart. Fruit small, bell-shaped, striped with dark green and white. It is used both in the green and ripe state. It is cultivated to a considerable extent for the New York market; and, although it is not so productive as some, yet it is said to be comparatively hardy, ripening well even in the coldest seasons.

8. CROWN GOURD—Bonnet d'Electeur and Pâtisson of the French, Scollop Gourd, Patty-pan of the Americans.—The plant forms a round bush, and does not run. The fruit, which is produced very close to the stem, is flat and scolloped on the edge. In America two sub-varieties are cultivated: the *Early Yellow Bush Scollop*, and the *Early White Bush Scollop*; both used when young and tender for boiling, and at maturity for making pies.

9. EGG, OR APPLE SQUASH—syn. Orange Gourd.—In size, form, and colour, this resembles an orange; hence its name. It bears abundantly; and trained on a pole, is very ornamental. It may be used in a young state, but in quality is not equal to the vegetable marrow. This is different from the Orange gourd of the East Indies, which is poisonous.

10. SPANISH GOURD—syn. Spanish Pumpkin; Potiron d'Espagne.—Fruit middle-sized, very flat; skin smooth and hard, usually green. Flesh firm, and of excellent flavour.

11. TURK'S CAP—syn. Turban Pumpkin, Giraumon Turban.—Fruit middle-sized, flat, with a rounded margin, and elevated centre, which is deep green; the rest is yellow, or pale green. Flesh firm. This variety is chiefly grown for ornament in this country; as are also various others, some of which are poisonous, such are the Bottle gourd, or false calabash, and the Orange gourd of the East Indies. Indeed, great caution should be exercised in eating the fruits of Cucurbitaceæ, for many of them are strong cathartics, inducing choleraic symptoms when partaken of.

All the sorts require a rich soil; in fact, they grow best on a dung-heap. The seeds should be sown in heat, in April, and forwarded under glass; but after the plants are above ground they should only be kept in very gentle heat. They must be shifted into larger pots, as may be necessary, and kept growing moderately, gradually exposing them to the open air, previous to planting out, which should be done when the weather becomes sufficiently mild in May, sooner or later, according to season and climate. After plant-

ing out, they should be protected by hand-glasses, or, at all events, they must, by some means, be protected from cold or frost at night. If heat is not at command, the seeds may be sown early in May, in pots, under a hand-glass; or, after the middle of May, they may be sown in the open ground.

HERB PATIENCE. See PATIENCE.

HOP, The (*Humulus Lupulus*, L.—Dioecia Pentandria, L.; Urticæ, D. C.; Cannabinaceæ, Lind.), is a perennial plant indigenous to this country. The use of its flowers in brewing is well known. In gardens it is principally grown as a screen to hide unsightly objects. Its young shoots, cut when about 4 inches in length, are occasionally used in spring, when they appear above ground, instead of asparagus; they are not, however, held in much esteem. The hop is a dioecious plant; that is, the male and female flowers are borne on separate individuals; the kind producing the female flowers is the one cultivated in the hop plantations, though the male kinds are grown for the purpose of impregnating the female flowers. Several varieties of the hop are distinguished by hop-growers; but it will be unnecessary to enter into these distinctions, as far as the cultivation of the plant in gardens is concerned.

It prefers a rich deep loam, and the ground should be deeply dug, and manured, if necessary, with *well-rotted stable dung*, mixed with the earth. It is propagated by parting the roots in spring, or autumn, or by cuttings of the shoots of the preceding year, taken off from the crown of the plant in March. If the plants are intended for the production of tops, they may be planted a foot apart, in rows 3 feet asunder; or in a single row, near any object which it may be desirable to hide. Poles or sticks should be placed for the bine to climb upon, and the ground should be kept free of weeds, and stirred in spring and autumn.

Insects, &c.—The roots of the hop are attacked by wireworms, and by the caterpillars of the otter or ghost-moth (*Hepialus humuli*); the young shoots are eaten off in spring as fast as they appear by the hop-flea (*Altica concinna*); the bine is devoured by the caterpillars of *Pyrallis rostralis*, *Larva pudibunda*, *Vanessa C-album*, and *V. Io*; whilst the leaves are perforated and their juices exhausted by the hop frog-fly (*Amblycephalus interruptus*), and by the hop-fly (*Aphis humuli*), the great scourge of the hop plantations.

The hop is liable to be attacked by a fatal disease, known as the *mould*, which appears to be a species of *Oidium*. It originates amongst the cellular tissue of the leaves, spreads with astonishing rapidity, exhausting the plant, and arresting its growth, so that in hop grounds the entire destruction of the crop is sometimes the consequence. Damp, and a deficiency of air and light, are favourable to the development of this disease. Sulphur is the best remedy.

HOREHOUND (*Marrubium vulgare*, L.—Dydynamia Gymnospermia, L.; Labiatae, D. C.; Lamiaceæ, Lind.) is a perennial plant, a native of Britain. Its leaves and tops have long been a popular remedy for coughs. Dr. Kittoe states, in the *Chemist*, that he has for many years been in the habit of employing horehound in cases of troublesome chronic cough, particularly in that species which is found so frequently after attacks of influenza, and other severe forms of cold; and that he invariably found that it restored the tone of the stomach, and subdued irritation, when other and more valued remedies had been employed in vain.

It may be propagated by dividing the plant in spring; by sowing the seeds in February, March, or April; or by cuttings, planted in a shady border, in April. Plant 18 inches apart, in a dry warm situation. All the care necessary is to keep the ground clean, and the plants will last for many years.

HORSE-RADISH (*Cochlearia Armoracia*, L.—Tetradynamia Siliculosa, L.; Cruciferae, D. C.; Brassicaceæ, Lind.)—The horse-radish is a hardy perennial, indigenous to, or naturalized in Britain. It is cultivated for its long roots, or, more properly, underground stems, the use of which, along with roast beef, is so well known that it need hardly be mentioned. They also sometimes form an ingredient in winter salads.

It grows well almost anywhere; but the best and most tender roots are produced in a deep, rich, and rather moist soil; a sandy loam, sufficiently moist, is well suited for its growth. It is propagated by planting the crowns, cut off with a piece of the root 2 inches in length attached; or by pieces of the root of the same length. The crowns are, however, the best. The ground where horse-radish is to be planted should be trenched 2 feet, or, if possible, 3 feet deep, in autumn, and manured, if necessary, with rotten cow-dung, which should be placed at the bottom of the trenches,

otherwise the roots are apt to ramify. The ground is allowed to lie in a rough state till January, February, or the beginning of March, when it should be again trenched 2 feet deep, and planting at once proceeded with. The sets should be planted in holes 15 or 18 inches deep, made by a dibber, and 1 foot apart, in rows 18 inches asunder, the holes being filled up with fine earth or coarse charcoal. The following directions for the cultivation of horse-radish are given by Mr. Joseph Knight:—

“Trench the ground 3 feet deep, and, if fresh grass-land, it should lie twelve months to pulverize, and will be improved by growing a crop of potatoes the first summer. In the following February, procure your sets, in the choice of which take the strongest crowns or leading buds from old plants, cutting them about 2 inches long. When a sufficient quantity is thus prepared, proceed to mark out the ground in 4-foot beds and 1-foot alleys, by strong durable oak-stakes; then take from the first bed 9 inches of the top soil, laying it upon the adjoining bed; after which take out an opening at one end of the bed, in the common way of trenching, 15 inches deep from the present surface; then level the bottom, upon which plant a row of sets across the bed, at 9 inches apart each way, with their crowns upright; afterwards dig the next trench the same width and depth, turning the earth into the first trench over the row of sets; thus proceeding trench after trench to the end.

“Where more than the produce of one bed is required for the supply of the family for twelve months, the third bed is next to be planted, which treat as directed for the first, only observing to lay the earth on the fourth, and so on, for any number of beds, being careful to leave the earth of the beds which are planted as light as possible, and taking great care to avoid treading them at any time until the crop is in a proper state to take up, or to plant or sow other crops upon the ground; but upon every alternate bed which is not planted a dwarf annual crop may be grown. About the month of May the plants will make their appearance, and in the course of the summer grow very strong. They must be kept clear from weeds; and as soon as the leaves decay in autumn, let them be carefully raked off with a wooden-toothed rake, which is all that is required until the following February, when 18 inches of the earth of the unplanted bed must be laid as light as possible,

and equal over the beds that are planted; then trench and plant the vacant beds exactly in the same manner as before directed. Let the same care be observed to keep the ground clear from weeds until the following autumn, by which time the plants will have made surprising progress. As soon as the leaves decay let them be taken off by a wooden rake, after which the first planted horse-radish may be taken up, by opening a trench at one end of the bed to the bottom of the roots, so that they may be taken up entire and sound; these, for size and quality, will be such as are not generally seen. It is also necessary to be very careful, in digging up the crop, to pick every lateral root and fibre out of the ground, as the smallest roots rarely fail to grow, and would, if left in the ground, injure the succeeding crop. The following February, the one-year old crop will require additional earth, as before directed, and must of course be taken from those beds which are now vacant; which, when done, if the ground appears poor, or unlikely to produce another vigorous crop, they must have a coat of manure.”—(*Horticultural Transactions*, vol. i. p. 207.)

The following mode of cultivation, practised in Denmark and Germany, is given by Mr. Petersen, in the *Transactions of the Horticultural Society of London*:—

“The ground must be trenched and manured the year before planting. In the autumn, when the old roots are taken out of the ground, select all the small side roots, from 9 to 12 inches in length, and as thick as a quill or thereabouts; tie them in bunches, and preserve them in sand, in a place protected from the frost during the winter. The planting is commenced in the beginning or middle of April. In dry weather divide the ground into beds 4 feet wide (some make them only 3 feet wide). These beds are with me raised a little with the mould out of the alleys, so that they are about a couple of inches higher in the middle than on the sides next the alleys. With a woollen cloth rub off all the lateral fibres from the roots above described; and also pare off each extremity, so that the wounds may be fresh; then plant them, by inserting them horizontally into the sides of the elevated beds, about 1 foot apart, in a quincuncial manner, so that the bottom part of the root is about 6 or 7 inches below the surface, and the top or crown end of the root stands a little out of the side of the bed, remarking that the

roots are to be inclined a little, so that their lower extremity is rather deeper than their upper.

"In the latter end of June, or some time in July, take and cut off with a sharp knife, all the lateral fibres of each root, which is done by placing the foot on the lower extremity, and carefully lifting the root out of the ground as far as may be necessary. This operation is performed two or three times every summer. When the operation is over, replace the roots as before, and cover them with mould. The roots or fibres which are left at the end of the main root, and not disturbed (for the operation must be done carefully), are sufficient to nourish the plant. In the third year the roots have attained their full size. Laying the roots horizontally has the advantage that they are easily taken out of the ground without breaking, while cutting off the side roots makes the main root grow straight and thick. It is advisable to plant a bed every year." —(*Horticultural Transactions*, second series, vol. i. p. 91.)

The ground should be occasionally forked, and at all times kept free of weeds. Two or three applications of liquid manure during the summer will also prove beneficial to the plants. From the autumn of the same year, some small roots may be taken up for immediate use, if there is no old plantation; but the main portion of the roots should not be taken up till the autumn of the second year, from which time till the succeeding autumn, they will be in perfection. In taking up the roots a trench should be opened as deep as the lower roots, so that they may be taken out as nearly whole as possible; for any portion that is broken off and left in the ground will certainly grow. For this reason, the horse-radish when once planted is very difficult to eradicate; the only method of doing so, being to remove all fragments as far as possible. The pungency of the roots being greatly diminished by keeping above ground, they should either be taken up as wanted, or a month's supply may be dug up at a time and preserved in earth in a shady border. At the approach of winter, a quantity should be preserved in sand or dry earth in a shed, for use during frosty weather. As roots more than three years old become hard and woody, a fresh plantation should be made every year in order to have a constant supply of roots in perfection. Some gardeners grow horse-radish for many years in the same place,

leaving the smaller roots in the ground as sets for the succeeding crop. This may answer tolerably well if manure be given; but even then we cannot recommend it as a practice to be followed for more than four or five years.

HYSSOP (*Hyssopus officinalis*, L.—*Didymia Gymnospermia*, L.; *Labiatae*, D. C.; *Lamiaceae*, Lind.) is an aromatic evergreen under-shrub, a native of the south of Europe. An infusion of the tops and flower-spikes is sometimes employed medicinally as an expectorant.

Three varieties are cultivated:—

1. COMMON, OR BLUE-FLOWERED HYSSOP.
2. RED-FLOWERED HYSSOP.
3. WHITE-FLOWERED HYSSOP.

Hyssop succeeds best in a light dry soil, with a warm aspect. It may be propagated by seed sown in April; by dividing the plant in February, March, or in autumn; or by cuttings made in April or May, and planted in a shaded situation, and watered until they take root. The plants raised from seed, and those from cuttings, may be planted out where they are to remain in June or July, at 1 foot apart each way, watering till they take fresh root. This plant is sometimes planted or sown as an edging, in which case it must be taken up and replanted every two or three years, in spring or autumn, otherwise it will become straggling. All the care the plants require is an occasional trimming.

INDIAN CRESS. See **NASTURTIUM**.

JERUSALEM ARTICHOKE (*Helianthus tuberosus*, L. — *Syngenesia Polygamia Frustranea*, L.; *Compositae*, D. C.; *Asteraceae*, Lind.)—The Jerusalem artichoke is a hardy tuberous-rooted perennial, a native of Brazil. It must not be supposed that this plant is an artichoke, for it is only so called in consequence of resembling that vegetable in flavour, and not because it belongs to the same family; neither does it come from Jerusalem, that word in this case being merely a corruption of the Italian name *girasole*.

The tubers are baked, roasted, or boiled, and are served up with milk or butter, and in various other ways. They are much liked by some persons, and their flavour, when properly cooked, is agreeable. The plant is also sometimes grown near preserves, for the winter feeding of pheasants, which are very fond of the tubers.

The Jerusalem artichoke was one of the many plants recommended as a substitute for the potato, and it is probably the best that

has as yet been proposed. It is much more hardy than the potato, as easily cultivated, thrives in the poorest soil, and in the worst situations; and the nutritive value of the tubers is very considerable. Their composition was ascertained by Braconnot to be as follows:—

Grape sugar,	14.800
Inuline,	3.000
Gum,	1.220
Albumen,.....	0.900
Fat,	0.090
Citrate of potash,.....	1.070
Phosphate of potash,	0.060
Sulphate of potash,	0.120
Phosphate of lime,	0.140
Citrate of lime,.....	0.080
Chloride of potassium,.....	0.080
Malate of potash,.....	0.030
Tartrate of lime,	0.015
Woody fibre,	1.220
Silica,.....	0.025
Water,	77.150
	<hr/> 100.000

The following summary of the average composition of the tubers of the Jerusalem artichoke, and those of the potato, will serve to show the comparative nutritive value of the two vegetables:—

	BOUSSINGAULT.		HORSFORD AND KROCKER.			
	Jerusalem Artichoke.		White Potatoes grown at Giessen.		Blue Potatoes grown at Giessen.	
	Natural State.	Dry.	Natural State.	Dry.	Natural State.	Dry.
Nitrogenized, or flesh-forming constituents,	2.38	10.00	2.49	9.94	2.37	7.63
Substances not containing nitrogen, and fitted to support respiration, or to produce fat,...	19.99	84.00	...	...	...	...
<i>a</i> , Starch, sugar, &c. ....	...	...	18.00	71.86	23.00	74.05
<i>b</i> , Fibre, ....	...	...	3.66	14.61	4.65	14.97
Ashes,	1.43	6.00	0.90	3.59	1.04	3.35
Water,	76.20	...	74.95	...	68.94	...
	100.00	100.00	100.00	100.00	100.00	100.00

From the above analyses, it appears that the Jerusalem artichoke contains a greater amount of water and inorganic matter than the potato; that the difference in the amount of the flesh-forming constituents which exist in the two vegetables, is so remarkably small, that, in this respect, they may be said to be on an equality; and that starch, which is found

so abundantly in the potato, does not occur in the Jerusalem artichoke, but is replaced by grape sugar, into which starch is converted in digestion, and inuline, which is merely a peculiar form of starch. It may be observed, that as an element of respiration, grape sugar is somewhat inferior to starch, 97 of the latter being equal to 106 of the former. From the preceding analyses, it may be concluded, that, as an article of food, the Jerusalem artichoke is, upon the whole, inferior in value to the potato, but that this inferiority is not great.

The Jerusalem artichoke will grow in almost any soil and situation, but succeeds best in a deep, friable, sandy loam, and in an open situation. It is propagated by planting small entire tubers, or pieces of larger ones, each piece being furnished with two or three eyes. Previous to planting, the ground should be deeply dug or trenched, and manured if necessary. The sets may be planted in the end of January, in February, or March, either in shallow trenches 4 or 5 inches deep, or in holes made to that depth with a dibber. They may be placed 1 foot apart, in rows 3 feet asunder. The rows should run north and south in order to admit the sun's rays, which would otherwise be to a great extent excluded by the luxuriant foliage of the plants facing the south. After planting, with the exception of hoeing the ground occasionally, and drawing a little earth to the stems, nothing further is required till November, when the tubers will be fit to take up. A quantity should be taken up and stored in sand, for use in frosty weather; but as the tubers are not injured by frost, and keep best in the ground, the greater portion of them may be allowed to remain to be taken up as wanted; if, however, the ground is required for other purposes, the whole crop may be taken up and pitted like potatoes. In digging up, which is best done with a fork, care should be taken to remove all the tubers as far as it is possible to do so, for any that are allowed to remain will spring up when the growing season arrives; for this reason, the plant is not easily eradicated from the spot where it has once been grown. A fresh plantation should be made every year.

The Jerusalem artichoke never produces seed in this country; according to M. Noisette it can only be saved from plants obtained from tubers freshly imported from America, for those which have been long cultivated in France cease to produce seed.

M. Vilmorin states, in the *Bon Jardinier*, that he has obtained several varieties from seed, some of them having yellow or yellowish white tubers, but of their value as compared with the common sort, we are not informed.

Insects.—The Jerusalem artichoke seldom sustains injury from insects, the only one which is known to be peculiar to the plant, is the Jerusalem artichoke aphid (*Rhizobius helianthemii*), which feeds upon the tubers; but as it is only found in small numbers, it does not do much damage.

KIDNEY-BEAN (*Phaseolus*, L.—*Diadelphia* Decandria, L.; *Leguminosæ*, D. C.; *Fabaceæ*, Lind.)—The kidney-bean is a tender annual, a native of India, and is probably indigenous to Cashmere, and other northern parts of that continent. It is the *Phaseolus vulgaris*, L.; but under this name it appears that several species have been confounded: these have been separated in De Candolle's *Prodromus*; however, as regards their cultivation, and for the sake of convenience, they may here be considered as forming only one.

The kidney-bean is an important and excellent vegetable, affording a large amount of produce from a small space. When the weather is sufficiently warm, it soon yields a supply, and continues to do so in succession for a long time. If the green pods are superabundant in summer, they may be preserved in salt, for use in winter; they may be made into a pickle alone, or together with other vegetables; and, finally, the ripe seeds can be used in a variety of ways, in haricots, soups, and stews.

The varieties are exceedingly numerous, and most of the principal ones being each designated by several names, much confusion and inconvenience is the result. The difficulties arising from this cause will be obviated, it is presumed, to a considerable extent, by dividing the different sorts as follows:—

- | | | |
|--------------------|---|--------------------------|
| A.—SEEDS WHITE, | { | § 1. <i>Dwarfs</i> . |
| | { | § 2. <i>Tall sorts</i> . |
| B.—SEEDS COLOURED, | { | § 3. <i>Dwarfs</i> . |
| | { | § 4. <i>Tall sorts</i> . |

A.—SEEDS WHITE.

§ 1.—*Dwarfs*.

1. **EARLY DWARF DUTCH**—syn. Dwarf White Dutch, Dwarf Dutch, Large White Dwarf Dutch, White Long-pod Dutch, Early Dwarf White, Nain hâtif de Hollande, Nain de Hol-

lande très hâtif.—Pods long, slender, excellent when green; seeds white, small, oblong, a little compressed. Suitable for forcing.

2. **DWARF CANTERBURY**—syn. Nain blanc sans parchemin.—Early, and a good bearer; the plants branch much near the ground; pods narrow; seeds small, oblong, white.

3. **DWARF BATTERSEA**—syn. Early Dwarf White, Earliest Dwarf Battersea.—This is somewhat earlier, but otherwise scarcely different from the preceding. Both are very old varieties.

4. **EARLY LAON**—syn. Early White, Dwarf White, Brewer's White, Nain hâtif de Laon, Flageolet.—Being very dwarf and early, it is adapted for forcing. The foliage is of a very dark green colour; pods fleshy and tender; seeds white, oblong, and nearly cylindrical. It is much cultivated near Paris, where it is esteemed both in the green and mature state.

5. **DWARF WHITE AMERICAN**—syn. Nain blanc d'Amérique.—The plant branches much, and forms a large bush, sometimes inclined to run, but generally remaining dwarf. It is very productive. The pods are short, thick, slightly curved, and marbled with brownish red, exceedingly crisp and tender. The seeds are small, oblong, and white.

6. **DWARF SABRE**—syn. Sabre nain.—The plant branches much, forming a large bush. It is very productive. Pods long and broad; seeds small, flat, and white. In the green state, the pods are good and tender till three parts grown; and the beans are excellent in the mature or dry state. Wet soils do not suit it, for the long pods produced near the ground are apt to spoil from contact with it. The **FRENCH WHITE**—syn. Nain blanc très productif—is closely allied to this sort.

7. **DWARF SOISSONS**—syn. Haricot de Soissons nain, Gros pied.—Seeds and pods similar to those of the Large Running White in colour, size, and quality. A good bearer, and although not an early sort, yet it is earlier than the preceding.

§ 2.—*Tall Sorts, or Runners*.

8. **LARGE RUNNING WHITE**—syn. Long White, White Long-pod, Large White Sugar, Tender-pod Bean Runner, Dutch Case-knife, De Soissons, Sabre à très grandes cosses, Haricot gigantesque.—Plants tall, seeds large, flat, and white; excellent in a dry state, and much cultivated for use in that way, especially at

Soissons, where it is said to acquire a finer flavour than anywhere else.

9. **SABRE**—syn. Haricot Sabre d'Allemagne, Selachtschwerdt-Stangenbohne of the Germans.—Plants tall, requiring strong sticks. Pods curved, remarkably large, from 10 to 14 inches in length, and about 1 inch in breadth when full-sized; tender, even when the seeds are half-grown, and they may then be used fresh, or they may be cut into narrow strips, and preserved with salt, for winter use. The dry seeds are tolerably large, flat, kidney-shaped, and white. In point of quality, whether in the green or dried state, the French rank this variety amongst the best. It does not, however, produce so long a succession of green pods as some others, neither does it bear so abundantly.

10. **HARICOT PREDOME**—syn. Prudhomme Prodomet.—Pods tender, even when large; seeds small, oval, grayish white. This variety is not well adapted for the climate of Britain.

11. **RICE HARICOT**—syn. Small White French Runner, Haricot Riz.—Bears abundantly, and is very good in a green state. The seeds are smaller than those of any other variety known; they are very fine, white, oblong; in the mature state, they are best when newly shelled. This sort is too tender to ripen its seeds in this climate, except in very warm situations.

B.—SEEDS COLOURED.

§ 3.—*Dwarfs.*

12. **DWARF SPECKLED CHINA**—syn. Dwarf China, Early China, Robin's Egg, Dwarf Robin's Egg, Early Dwarf Pink-spotted.—An early dwarf variety, adapted for forcing; but it is now superseded by the following.

13. **WILMOT'S FORCING CREAM-SPECKLED**—syn. Wilmot's Early Speckled.—Pods long, crisp, and tender; seeds oblong, of a pale dun colour, speckled with dark chestnut. An abundant bearer, and an excellent forcing variety.

14. **DWARF YELLOW CANADIAN**—syn. Nain jaune du Canada.—Very dwarf and early. Pods very tender and excellent; seeds nearly round, pale yellow, with a small brownish circle round the hilum; very good when dry.

15. **FULMER'S EARLY DWARF**—syn. Fulmer's New Dwarf, Fulmer or Fulmer's Dark Red, Early Dun, Dwarf Dun-coloured, Dwarf Forcing Dun-coloured, Early Frame, Earliest Forcing.—Dwarf, early and good for forcing. Pods

long, narrow, and tender; seeds small, dun-coloured when ripe.

16. **NEWINGTON WONDER**.—Very dwarf, about 1 foot high; early and productive. Pods of a dark green colour, of medium length, not very broad, but with thick, fleshy sides, within which the seeds form slowly; the pods remain long crisp and excellent. The mature seeds are small, oblong, light chestnut-coloured.

17. **CRIMSON**—syn. Rouge d'Orleans.—Seeds red, small, and flat; much esteemed in a dry state for stews.

There are many varieties of Swiss kidney-beans. The French distinguish the *Blanc* (it is rather cream-coloured); the *Rouge*, the *Gris*, the *Gris de Bagnolet*, the *Plein de la Flèche*, and the *Ventre de biche*, as the principal. These varieties are allied by their quality, and by the oblong form of the seeds. The *Gris de Bagnolet* is known in this country as the Dwarf Black Speckled; and the *Rouge* as the Dwarf Red Speckled.

18. **CREAM-COLOURED SWISS**—syn. Suisse blanc.—Tolerably dwarf, rather late; young pods excellent; seeds long, cylindrical, cream-coloured.

19. **GRAY SWISS**—syn. Suisse gris.—Seeds oblong, dark red, marbled with white. Good for use both in the green and dried state.

20. **PLEIN DE LA FLECHE**.—Decidedly dwarf and early; much grown in the department of the Maine. The pods are narrow, and continue to form in long succession.

21. **VENTRE DE BICHE**.—Plant inclined to run. Pods slender and very good; seeds oblong; excellent in soups.

22. **DWARF RED SPECKLED**—syn. Fulmer's Speckled Dwarf, Dwarf Light Red Speckled, Early Dwarf Forcing Speckled, Long Spotted French, Suisse rouge.—Seeds oblong, cylindrical, speckled with light and dark red. Used both in the green and dry state.

23. **DWARF BLACK SPECKLED**—syn. Dwarf Black Spotted, Dwarf Black Mottled, Suisse gris de Bagnolet.—Dwarf, and not apt to run, as most of the Swiss varieties are inclined to do. It is largely cultivated near Paris, for the pods in a fresh state, and also for the dried seeds, to be preserved for winter use; they are of a grayish colour, spotted with black or dark red.

24. **EARLY DWARF PURPLE SPECKLED**—syn. Early Purple, Dwarf Speckled, Dwarf Purple Speckled.—Closely allied to the preceding.

25. **BUSH HARICOT**—syn. Haricot solitaire.

—This grows about 15 inches high, and throws out a number of branches near the ground, forming a sort of bush. The shoots successively emitted bear in succession, whilst they shade the ground, and tend to keep it moist in dry weather. The pods are produced abundantly, and even when 5 inches in length, they are still crisp, transparent, and excellent. They commence to form tolerably early, and they continue long fit for gathering in succession. The seeds are speckled or marbled with red and white.

26. DWARF NEGRO—syn. Early Negro, Early Black, Nain noir, Nègre.—A very productive variety, extensively cultivated in the market gardens in the vicinity of London.

27. BLACK BELGIAN—syn. Haricot noir de Belgique.—An excellent sort, bearing considerable resemblance to the Dwarf Negro, but differing from it in having darker green foliage, and in being dwarfer and earlier. It is good for forcing, and for the earliest and latest crops in the open ground. Being very dwarf, it may be sown and forwarded in pots, but well exposed in favourable intervals till the ground becomes sufficiently warm, and if then planted out, it will soon come into bearing. Again, for a very late crop, if sown at an advanced period of the season, it will produce pods till cut off by frost; whilst most other sorts, if sown at the same time, would not even blossom.

28. LONG-PODDED NEGRO.—A new variety of the Negro, later, taller, and of stronger growth, producing broad luxuriant foliage, and consequently requiring to be planted at wider distances. The pods are long, of uniform breadth, and very succulent. In rich soil, the plants should be topped, so as to be little more than 1 foot high.

§ 4.—*Tall Sorts, or Runners.*

29. RED PRAGUE—syn. Haricot Pois rouge, Haricot de Prague rouge sans paremin.—Plants tall, requiring sticks; late, but very productive in fine autumns. Pods tender; seeds round, purplish red when ripe, rather thick-skinned; but mealy, and of good flavour, similar to that of a chestnut.

30. PRAGUE BICOLOR.—A variety of the preceding, possessing the same qualities. The seeds are likewise round, but somewhat larger than those of the Red Prague.

31. PRAGUE JASPE—syn. Haricot chou.—A

tall running sort. Pods rather thin-sided, and the seeds become soon prominent; therefore, its cultivation for use in a green state is not to be recommended. The dry seeds, however, are said to be of excellent quality, and on this account the sort is much cultivated near Paris.

32. BAUDIN—syn. Prague marbré nain—is a sub-variety of the preceding, and of a dwarfer habit.

The Prague varieties are not much to be recommended for this climate. The green pods soon become unfit for use; the plants require sticks; and our seasons are occasionally too cold for them.

33. LAFAYETTE resembles the Sabre in the size and length of the pods, which hang in clusters. The seeds are whitish, marbled with light fawn colour.

34. ALGIERS—syn. Haricot d'Alger, Haricot beurre, Haricot ciré.—According to the *Bon Jardinier*, this variety has long been cultivated in Lorraine, but has lately been reproduced under the name of Haricot beurre and Haricot ciré. The plants are runners, and consequently require sticks, or to be topped if these cannot be afforded. It is amongst the earliest of the tall sorts. The pods are of a pale yellowish colour, and entirely destitute of any tough lining. They are exceedingly tender, and soft, like butter, when cooked. The seeds are middle-sized, roundish, and black. It is not an early sort, neither will it fruit if sown late.

Soil, Manure, and Situation.—Originally from the warm parts of the world, it may easily be conceived that the kidney-bean requires a warm soil and situation. In fact, when the ground is cold and wet, the seeds will rot rather than vegetate. For early crops, more especially, a rich sandy loam is desirable, and as warm a situation as can be afforded, such as the border in front of a south wall, or along the bottom of a wooden fence, or, in short, any situation that is well sheltered, but at the same time exposed as fully as possible to the sun. For the main crops, however, any well-conditioned garden soil will answer. It should be of such a nature as not to retain stagnant water about the roots; for though these require moisture, yet a saturated condition of the ground is very injurious to them. For the latest crops a light warm soil and a good situation, similar to that for early crops, should again be chosen. In the northern parts

of the kingdom it may, in some cases, be advisable to depend chiefly for a supply on the dwarfest sorts grown on a south border.

As regards manure, none is required where the soil is rich, and has been manured for the previous crop; but, where the soil is not sufficiently rich, half-rotted stable dung is good for the early sown crop; and for this, a compost of light hot-bed dung and leaf-mould, the whole in a state that will readily permit the passage of water, may be put into the drills, made deeper than usual for the purpose of receiving it. This will afford nourishment to start the plants, and at the same time will act as drainage. A mixture of leaf-mould, or decomposed dung and dry fibrous turf, will have a similar beneficial effect. In such substances the roots will thrive better than when they are in contact with cold soil, saturated with water. For the main crop well-rotted manure is preferable, unless the soil is rather strong and damp; and in this case horse-dung not much decomposed may be used.

Time and Manner of Sowing.—The principal sowing for the main crop should be made in the first week in May. The earliest may, under favourable circumstances, be made in the end of March; but more frequently the beginning of April will be as soon as the ground will be sufficiently warm. The latest crop should be sown earlier or later in July, according to the climate. These, and a few intermediate sowings, will suffice to produce a constant supply during the time that kidney-beans can be expected from the open ground.

The best time for sowing the main crop in the open ground is, as previously stated, in the first week of May, somewhat earlier or later, according to the season and climate. Whilst the temperature of the soil is below 45°, kidney-beans make but little progress. If they do appear above ground, the foliage is yellow and sickly, and many blanks occur.

A second sowing, under favourable circumstances, frequently yields an earlier, and generally a better produce than is obtained from the first sowing. But where there is little or no opportunity of forcing kidney-beans, it is desirable to use every available means to procure them from the open ground as early as possible; and, even where they are kept in vineries or other houses, the gardener is glad to dispense with them as soon as he well can; for, unless he, fortunately, have a house or pits for the purpose of forcing these things, he

must look on his in-door crop as a great pest, on account of the sustenance which the plants afford to the red spider, the spread of which alarms him for the safety of his principal crops of forced fruits. It is, therefore, advisable to sow in the end of March, in small pots, in moderate heat, and to keep the plants well sheltered at night till they can be transplanted out of doors; or they may be sown in a frame, in rows 6 inches apart, and 2 inches asunder in the rows, and if likely to become too tall before the weather admits of their being planted out, they may be topped once or twice, or they may be shifted; and sometimes, early in April, they can be placed in pots, close to the bottom of a wall, and afterwards planted out in rows across the border. For the earliest out-of-doors crop it is easy to protect the plants from frost, and the soil from being chilled, by means of neatly-made well-thatched hurdles, placed sloping on bearers supported by posts.

In some seasons the ground acquires as much heat by the end of March as it does in others at the end of April. When this is the case, the opportunity may be taken of making a small sowing in the end of March, and another in the beginning of April. If they should not succeed it is but little loss except the few seeds, for the ground can be dug over, and at the first favourable opportunity sown again. If, on the contrary, they go on favourably, another sowing need not be made till the third week in April. The main sowing is then to be attended to in the beginning of May; and for a succession a sowing should take place in the beginning of June, and this will be sufficient till the latest sowing, which should consist of one or two of the earliest sorts, is made in July.

Culture.—The open air cultivation of this vegetable is very simple. The seeds, especially, if more than one year old, should be steeped six hours before sowing. When the ground is prepared, drills should be drawn so as to admit of the seeds being covered $1\frac{1}{2}$ or 2 inches deep. The direction of the drills for the early crop on a border in front of a south aspect wall, may be oblique, from north-west to south-east. By this arrangement, the sun's rays, when hottest, will fall almost perpendicularly, and consequently with the greatest effect, on the sides of the ridges formed by earthing up the plants, the rooting of which will be encouraged by the soil being thus heated. The distance between the rows should

be about 2 feet. Where the soil is not very rich, some of the dwarfest sorts may be in rows only 18 inches apart, and the plants from 4 to 6 inches from each other in the row. For some of the tall kidney-beans $2\frac{1}{2}$ or even 3 feet may be allowed, and the plants may be from 6 to 8 inches apart in the rows. Some plant in patches. For the earliest and latest crops this may be done with some advantage as regards shelter; for example, hand-glasses could be placed over the patches when sown, and whilst the plants are being reared in spring; and, in autumn, circular basket-work, covered with some warm material, may be employed for protecting the patches from frost.

The subsequent cultivation consists in watering when needful, stirring the soil, and earthing up. The latter operation is not absolutely necessary, yet in wet seasons, and in cold soils, it is of considerable utility, for it has been observed, that, when the lower fibres of the root have mostly perished from much wet, fresh fibres have pushed from the stem in the upper part of the ridge. The running kinds should be stuck like pease, if sticks can be cheaply and easily obtained; but if not, the running tops should be cut or pinched off when the plants are from $1\frac{1}{2}$ to 2 feet high.

Gathering the Crop.—In some cases the pods are required very small and young; in others they are allowed to be considerably larger; but in all cases they ought to be gathered whilst they are so crisp as to be readily snapped quite in two when bent. When the seeds are to be used in the dry state, the crop should be only gathered when the pods are quite dried up. In gathering for use in the state of green pods, none should be left that are getting too old. If all the older ones are timeously removed, new ones will continue to be formed in great abundance; whereas, if pods are allowed to remain till the seeds approach maturity, the formation of young ones in succession is, in a great measure, prevented.

To save Seed.—The best seed is produced from plants sown at the earliest season that their growth can proceed without a check, and this is generally the case with the May sowing. The first formed pods should be reserved, except some of the smallest, which may be thinned out. After a considerable number of pods have been thus reserved on each plant, it will be advisable to gather, in a young state, all that may be subsequently

produced. By these means plump and well-matured seeds will be obtained.

Insects.—Kidney-beans, both in hot-houses and in the open air frequently suffer from the attacks of the red spider (*Acarus telarius*), which, by exhausting the leaves of their juices, enfeebles, defoliates, and ultimately kills the plants, if its progress is not arrested. The red spider is always most numerous where there is a deficient supply of moisture; accordingly, it is found to be more destructive in warm dry seasons than when the contrary is the case. Dusting with flowers of sulphur, and syringing strongly with water, are amongst the best modes of freeing the plants from this troublesome insect. Several species of thrips also attack kidney-beans, especially when these are grown in forcing structures. They are destroyed by the same means as the red spider. Snails and slugs are also sometimes very destructive to young plants in the open ground.

THE SCARLET RUNNER (*Phaseolus multiflorus*, Wild.) is a half-hardy perennial, a native of South America. Being commonly grown in cottage gardens, both for use and ornament, it is well known to every one. It is not, however, so generally known that the plant is a perennial, having tuberous roots like the dahlia; and that these, after having been preserved during the winter in any dry place out of the reach of frost, and planted out in spring, will yield another crop earlier in the season than that afforded by plants raised from seed. It may here be remarked that the roots of the scarlet runner are very poisonous.

The varieties are:—

1. SCARLET RUNNER — syn. Tall Scarlet Runner, Haricot d'Espagne, Haricot écarlate.—Grows from 9 to 12 feet high. Flowers scarlet. Seeds dark red; pods rough on the outside, and on that account less esteemed than kidney-beans; nevertheless they are more tender when cooked than kidney-beans, even if these are gathered when of much less size.

2. WHITE RUNNER — syn. White Dutch Runner, Haricot d'Espagne à fleur blanche.—A variety of the preceding with white flowers and seeds. For alimentary purposes it is preferred to the Scarlet by the French; it does not continue so long in flower and bearing as that sort, which is therefore the more useful of the two; but for ornament a few of the White may be intermixed with the Scarlet kind.

3. PAINTED LADY—syn. York and Lancaster, Haricot d'Espagne à fleur bicolor.—Flowers bright scarlet and pure white; very ornamental; but, as regards quality and productiveness, this sort is scarcely equal to the Scarlet.

Cultivation.—The same mode of cultivation is applicable to all three varieties. The soil should be rich, rather deep, not dry and thin, and by no means cold and wet. As the plants are too tall and rambling for borders, the seeds should be sown in the open quarters; and as they are not required so early as the other kidney-beans, which are better adapted for affording an early supply, the crop of runners need not be risked by sowing too early. The first week in May will be soon enough for the first sowing. If it come up well, and be likely to go on favourably, another sowing need not be made till the beginning of June; but if it is checked by cold weather, another sowing should take place in the third week in May, or as soon as the weather is favourable. Two sowings will generally be sufficient, or at all events there need not be more than three, namely, one in the beginning of May, another in the end of that month, and a third in the middle of June. Plants raised from these sowings will afford green pods till destroyed by frost.

Scarlet runners are grown in various ways. A common method in the large market gardens near London, is to sow at from 8 to 12 inches apart, in rows 3 or 4 feet asunder, according to the richness of the soil. The plants are not supported by sticks, but kept dwarf by pinching or cutting off the twining tops when from 2 to 2½ feet high. In private gardens, the rows are, or should be, at least 4 feet apart, and the plants ought to be supported by sticks like those used for pease. The sticks require to be strong, otherwise, when loaded with the plants, high winds sway the whole to one side. In many cases, such sticks cannot be procured; when this is the case, it is a good plan to sow in patches or circles of about 2 feet in diameter, and 6 feet apart, six seeds being placed in the circumference of each circle. Three sticks, on which the branches and twigs are retained, should be stuck in at three equidistant points, just outside the circle, and their tops brought together and tied. Secured in this way, the sticks will afford good support. The ground can also be planted with some crop, such as broccoli, &c., in the intervals.

It has been previously stated, that by preserving the roots of the scarlet runner during the winter, an earlier produce will be obtained than would otherwise be the case. With reference to this, Mr. Cuthill makes the following remarks:—

“In November, 1830, I saved a number of roots of scarlet runner, and stored them in moderately damp mould away from frost. These same roots were planted out in single rows, 1 foot asunder, some time in March, or early in April, the crowns being placed ½ inch below the surface. Scarlet runners were sown in rows at the same time. The transplanted roots came into bearing just one month before the sown seed. This afforded me a lesson which I did not forget. I have had several roots three years old; but one in particular I grew for seven years, and this one I exhibited at the May show at Chiswick in 1834. Many were surprised to see a scarlet runner 10 feet high full of flowers and beans, the produce of a plant forced in a vinery. From this little experiment, I would infer, that if cottagers saved their roots in autumn, and put them carefully by, they would have this valuable vegetable a month earlier on their tables than they now do.”—(*Gardeners' Chronicle*, 1850, p. 134.)

Mr. Cuthill recommends the roots to be saved in autumn, packed away like dahlia roots, and replanted in March, 6 inches apart, in rows 5 feet asunder.

When the plants are growing slowly, or whilst the soil and air is colder than is congenial to them, they will not require much water; but when in vigorous growth, and the pods forming abundantly, plenty of water should be supplied, but not from a cold spring. Earth should be drawn to the stems, as directed for kidney-beans. In training straggling shoots to any support that may be employed, they should be directed from right to left, or contrary to the course of the sun. If turned otherwise, they will not go on. Gathering the crop and saving seed are conducted on the same principles as explained for those proceedings in the case of the kidney-bean, and they therefore need not be again detailed.

KOHL RABI, or Turnip-Cabbage (*Brassica oleracea Caulo-rapa*, D. C.—*Tetradynamia Siliquosa*, L.; Cruciferae, D. C.; Brassicaceae, Lind.)—This holds a place intermediate between the cabbage and the turnip, the upper part of the stem swelling into a round fleshy head, re-

sembling a turnip in appearance; and it may be used for the same purposes as that esculent. This plant must not be confounded with the turnip-rooted cabbage, or Chou-navet of the French, the root of which is swelled into a tuber at the origin of the stem, and which belongs to *Brassica campestris Napo-Brassica*, D. C., a race in which the Swedish turnip is also comprised.

Kohl rabi is exceedingly hardy, withstanding even severe frost. It also resists drought better than the turnip; but in every other respect it is inferior to that vegetable. Though much cultivated in Germany, it is only now beginning to find its way into English gardens, in which, however, it deserves a place.

The principal varieties are:—

1. **WHITE KOHL RABI**—syn. Hungarian Turnip.—Bulb large, when full-grown from 8 to 10 lbs. in weight, more or less, according to circumstances of soil and climate; it is supported on a stem about 6 inches high. It is the latest sort, and is chiefly employed as food for cattle.

2. **PURPLE KOHL RABI**.—Skin of the bulb purple, with which colour the foot-stalks and veins of the leaves are also tinged. Like the preceding, it is only adapted for field culture, not being fine enough for a garden vegetable.

3. **EARLY DWARF KOHL RABI**—syn. Chou-rave nain hâtif.—Bulb white, and supported nearly close to the ground; leaves few and small. It is early as compared to the two preceding sorts, and was the best for garden purposes till superseded by the two following.

4. **EARLY WHITE VIENNA KOHL RABI**—syn. Chou-rave blanc hâtif de Vienne, Chou-rave blanc très hâtif de Vienne.—Dwarf, small, early; bulb handsome, firm, glossy, white, or very pale green. The leaves are few, small, with slender foot-stalks, the bases of which are dilated, and thin where they spring from different parts on the surface of the bulb. The flesh is white, tender, and succulent; whilst the bulb is young, or till it attains the size of an early white Dutch turnip; and at or under this size, it should be used.

5. **EARLY PURPLE VIENNA KOHL RABI**—syn. Chou-rave violet hâtif de Vienne, Chou-rave violet très hâtif de Vienne.—This corresponds with the preceding, except in colour, which in this sort is a beautiful purple, with a fine glaucous bloom. The foot-stalks and leaves are very smooth, few and slender.

These two varieties, obtained from Vienna,

are by far the best for table use; and when taken young, and properly dressed, they form an excellent substitute for turnips, especially in dry seasons, when a crop of the latter may fail or become of inferior quality, in consequence of drought or insects.

6. **CUT-LEAVED KOHL RABI**—syn. Artichoke-leaved Kohl Rabi, Chou-rave à feuille découpée.—The leaves of this sort are beautifully cut, and very ornamental. It was imported from Germany into France, under the name of Chou-rave à feuilles d'artichaut, and was so named from some of the leaves resembling the leaf of the artichoke. The fleshy portion is smaller than that of the Early Dwarf kohl rabi, from which this variety is supposed to have originated.

Kohl rabi may be sown either thinly broadcast or in drills 4 inches apart, in April, May, June, and July. When the young plants are an inch or two in height, they may be transplanted into any good, well-manured piece of ground, planting them 8 inches apart, in rows 15 inches asunder, and not deeper in the ground than they were in the seed-bed. Water should be given till they take fresh root, and subsequently in dry weather, as required; for though the plant suffers little from drought, yet the tenderness of the produce is greatly impaired by an insufficient supply of moisture. With the exception of stirring the ground and weeding, no further culture is required.

The crop will be fit for use when the bulbs are of the size of an early Dutch turnip; when allowed to get much larger than that, it is only fit for feeding cattle. In the varieties grown in the fields, the bulbs sometimes attain an immense size, weighing, in some cases, as much as 14 lbs.

The kohl rabi possesses an important advantage over the turnip, inasmuch as it rarely suffers from the attacks of insects or diseases.

LAMB'S LETTUCE. See CORN SALAD.

LAVENDER (*Lavandula Spica*, L.—*Didynamia Gymnospermia*, L.; Labiatae, D. C.; Lamiales, Lind.) is an aromatic under shrub, a native of the south of Europe. It is cultivated in almost every garden for its flowers, which are dried and put into wardrobes. They yield, on distillation, the highly-esteemed perfume, lavender-water; and for this purpose it is grown on a large scale in the neighbourhood of Mitcham, in Surrey, upwards of 200 acres being occupied with lavender alone.

There are three varieties:—

1. NARROW-LEAVED BLUE-FLOWERED, OR COMMON LAVENDER.

2. NARROW-LEAVED WHITE-FLOWERED LAVENDER.

3. BROAD-LEAVED LAVENDER.

Lavender succeeds best in a light, warm, and dry soil; in such, also, it resists frost better, and is more aromatic than when planted in a rich moist one. It may be raised from seed sown in spring; but the universal method of propagating it is by slips taken off, if possible, with roots in March, April, or September. These should be planted deeply in rows 2 feet apart, and 1 foot from plant to plant in the rows, water being given till the plants are well established. The ground should be hoed occasionally, and the plants trimmed of over-luxuriant and straggling shoots and withered flower-stalks. The flowers are produced in July and August, and the spikes should be cut off close to the stem when the blossoms on the lower part begin to change to a brown colour.

LEEK (*Allium Porrum*, L.—Hexandria Monogynia, L.; Liliaceæ, D. C.; Liliaceæ, Lind.)—The leek is a hardy biennial plant, said to be a native of Switzerland. It was cultivated in this country prior to 1562.

The varieties are:—

1. LONDON FLAG—syn. Large Flag, English Flag, Tall London.—Tall, with a thick stem; leaves broad; the sort most generally cultivated.

2. MUSSELBURGH—syn. Scotch Flag, Edinburgh Improved.—Very large and hardy; leaves broad and tall; stems long and thick.

3. LARGE ROUEN—syn. Very Large Rouen, Gros de Rouen, Très gros de Rouen, Gros court de Rouen.—Leaves very dark green, broad, and of thick substance. Stem rather short, but remarkably thick. It is said to grow as thick as a man's arm in the soil and climate of Normandy. It is now the sort most cultivated near Paris, and since its introduction to this country, it has been much approved of by all who have seen it. It is found to be the best kind for forcing, as it acquires a sufficient thickness of stem sooner than any other. It is one of the best, if not the best, that can be grown.

4. YELLOW POITOU—syn. Poireau jaune de Poitou.—A very large sort, the leaves having sometimes measured 5 feet in length, and upwards of 6 inches broad. They are of a yellowish green colour. The underground

or blanched part of the stem is yellowish white, and boils more tender than that of any other variety. On this account, and for its large size, it deserves cultivation. Owing to the great length of the leaves, the plants should be allowed more space than the other varieties.

5. SMALL EARLY NETHERLANDS LEEK—syn. Poireau d'été petit de Brabant.—Leaves long, narrow, dark green; stem small. On this account, it is not so well adapted as various others for a main crop; besides, if sown at the same time as they are, it is apt to run to seed before winter. A small sowing of it may, however, be made with advantage for early use.

The leek prefers a light, rich soil, and an open situation; if the ground where it is to be grown require manure, well-decomposed stable dung should be applied in the autumn of the year, previous to sowing, for strong and recent manure is injurious to this crop. The seed should be sown thinly broadcast, on a seed-bed, and lightly covered with earth, which should be pressed with the back of the spade; or it may be sown in shallow drills 6 inches apart.

A small quantity to come in early may be sown about the middle or end of February, if the weather is favourable. The principal crop should be sown about the middle of March, and a small quantity for a succession in the end of April. With the exception of thinning where too close, watering in dry weather, and keeping the ground free of weeds, nothing further is required till June, when the young plants of the main crop will be fit for planting out; those of the late crop may be planted out in August. A moist day should be chosen for the operation, or in default of that, the ground should be previously well watered; and after the water has subsided, so as to leave the ground in good working order, but still moist, planting may be proceeded with. The plants may be replanted in four ways:—

1. In the bottom of a furrow, or trench, about 6 inches deep, the earth being drawn in as the plants grow larger, so as at last to fill the furrows level with the rest of the ground.

2. Holes about $3\frac{1}{2}$ inches in diameter may be made with a large blunt dibber, and in these the plants should be placed upright, allowing little more earth to fall in at the time than is sufficient to cover the roots, or, at all events, not more than will come up as

far on the stem as the latter was in the ground previously. The soil will gradually be washed into the hole by rains, or it works in by hoeing; but, if lumpy, it had better be made fine, and put in with a trowel.

3. A good spade wide, or even a foot opening may be taken out along one side of the quarter, and the soil taken where it will be required to fill up the last opening. Dig over and level about 1 foot wide from the side; then at 9 inches from the latter stretch the line, cut down perpendicularly by it with the spade, and bring back the 3 inches towards the undug ground, then plant the leeks against the perpendicular cut made by the line in the newly dug ground, spreading their roots, and placing them as low as can be done without burying the hearts of the plants when the soil is made level. The ground can even be lowered after planting the row, so as not to cover the green part of the bases of the leaves, or, at most, but very little of them.

4. They may be planted on the surface by the dibber quite as deep in the ground as they previously were, and be so allowed to grow; and, as they advance in growth, they may be gradually earthed up.

In shallow soils, or where there is a damp subsoil, it will be advisable to adopt the last method; but where the contrary is the case, the largest and best blanched stems are obtained by the other methods, and of these the second is, in our opinion, the best.

The plants may be planted 9 inches apart, in rows from 12 to 18 inches asunder, according to the greater or less richness of the soil, and the size that the sort usually attains. Water should be given at planting, and moderately afterwards, till the leeks take fresh roots. With the exception of loosening the soil with the hoe, and drawing earth to the stems, where that method is adopted, nothing further is required. In September the leeks will be fit for use, and will continue so throughout the winter and spring—those of the late sowing till the end of April. Any then remaining may be taken up, and planted close together, but not touching each other, in deep trenches, in a cool situation, in order to prevent them from running to stalk. With the same view, the bottom from which the roots proceed may be cut off, and the leeks kept in a cool cellar.

In order to obtain seed, some of the largest and most vigorous plants should be taken up

in the beginning of March, and planted in a warm situation, sheltered from the wind. The seed ripens in autumn, and its maturity is known by the heads changing to a brown colour. It keeps best in the heads, and these should be cut off with a portion of the stalk a foot long, tied in bunches, and hung up in a dry airy shed. In this way the seed will retain its vegetative powers for two or three years; after that time it is not to be depended on.

LENTIL (*Ervum Lens*, L.—*Diadelphia Decandria*, L.; *Leguminosæ*, D. C.; *Fabaceæ*, Lind.)—The lentil (Fig. 158) is an annual

Fig. 158.



plant, a native of the south of France. Near Paris it is largely cultivated, both in fields and gardens, for the seeds, which are much used in cookery; nevertheless, there is little doubt that they are very unwholesome, being hard and difficult of digestion. It prefers a light, warm, dry soil; if planted in one that is rich it grows vigorously, but produces only a small quantity of seeds. It should be sown in the end of March or beginning of April, in drills 20 inches asunder. When the stems

begin to turn yellow, and the pods change to a darker colour, the plants are pulled up, dried in the sun for two or three days, and carried under cover. The lentils should not be thrashed till required for use, for it is found that they keep best in the husk; in this way they remain fit for use or sowing for two years.

LETTUCE (*Lactuca sativa*, L.—Syngenesia Polygamia Æqualis, L.; Compositæ, D. C.; Asteracæ, Lind.)—The lettuce is a hardy annual, which has been cultivated in this country ever since 1562, and probably before that time. It is generally considered to be a native of Asia, but of what part of that continent is not certainly known. De Candolle supposed it to have been brought from India, his opinion being founded on its supposed identity with the *Lactuca bracteata* of Wallich, found wild on the mountains of Nepaul. Several varieties appear, from their names, to have come from the Greek archipelago, and the coast of the Levant. Indeed, one of the two divisions into which the varieties of lettuce are classed, derives its name from the island of Cos, the modern Stancho.

The varieties of lettuce are divided into two classes:—I. CABBAGE LETTUCES, which includes those with round or spreading heads; and, II. COS LETTUCES, or those which grow erect, and of an oblong form. These divisions consist of a vast number of varieties, the principal of which are:—

I.—CABBAGE LETTUCES.

1. **HAMMERSMITH HARDY GREEN**—syn. Hardy Hammersmith, Hardy Green, Green Dutch, Green Cabbage, Early Dwarf Dutch, Early Frame, Prussian Cabbage Lettuce, Roman Cabbage Lettuce, Lattughe verde.—Leaves of thick substance, dark green, wrinkled, and concave. Seeds white. This sort has long been extensively cultivated on account of its standing the winter better than any other variety known. Sow about the middle of August, and again a month later, for winter and early spring use. It is an excellent winter lettuce, but soon runs to seed in summer.

2. **TENNIS BALL**—syn. Green Ball, Button, Capucine.—Leaves dark green, slightly curled; inner leaves forming a small but compact heart, blanching white and crisp. Seeds black. Hardy, and longer in running to seed than the preceding. It is sown at the same time as that sort, and will afford a succession to it.

3. **LAITUE PETIT NOIRE**—syn. Crêpe.—Small, but quickly forms a heart, which is very white. Employed in forcing.

4. **BLACK-SEEDED GOTTE**—syn. Laitue Gotte à graine noire.—This grows very close to the ground. Leaves forming a compact white heart, about 4 inches in diameter, of excellent quality. Seeds black. It is allied to the Tennis Ball, but its leaves are more curled and of a lighter green than those of that sort; and it does not so readily run to seed, even in summer. It is one of the sorts employed in France for winter forcing.

5. **LAITUE GEORGE**.—A sub-variety of the Gotte, forming a larger head; seeds white. Near Paris it is much esteemed for winter forcing, in which it is made to form a succession to the Gotte lettuces.

6. **WHITE DUTCH**—syn. Early Cabbage, Early Green for forcing, Early Yellow, Laitue à bord rouge, or Cordon rouge.—Somewhat larger than the Hardy Hammersmith. Leaves roundish, yellowish green, tinged with reddish brown at the top; hearts readily, and is hardy. With a little protection in winter it is very good for spring use. Seeds white.

7. **BROWN DUTCH**.—This bears considerable resemblance to the White Dutch, but the leaves are of a darker green on the under side, and more brown where exposed. It cabbages freely, and forms a good-sized head, which blanches white, crisp, and of excellent quality. It is not so hardy as some of the smaller sorts already described; but it is considered the hardiest of its size.

8. **MALTA**—syn. Laitue de Malte.—Scarcely so large as the White Silesian, of which it is considered to be an improved variety. The leaves are pale green, smooth and soft, dentate, but not curled on the margins. The head is flat, compact, and blanches white and very tender, though less crisp than the Neapolitan, to which, however, on account of its peculiarly soft texture, it is by some preferred.

9. **NEAPOLITAN CABBAGE LETTUCE**—syn. Laitue Chou de Naples.—Very dwarf. Leaves much curled on the edges. Head large, firm, white, crisp, and of excellent quality. Seeds white. This is considered the best of the summer cabbage lettuces. It soon begins to heart, yet it is longer in running to seed than any other cabbage lettuce.

10. **VERSAILLES**—syn. Laitue de Versailles, Versailles blonde, Swedish or Sugar Lettuce of some.—Leaves paler green than those of

the Neapolitan, and the heart not so firm; yet it is white, crisp, and of excellent quality.

11. **WHITE SILESIAN**—syn. Drumhead, Imperial, Large Green-headed Cabbage Lettuce, Spanish, Batavia blonde, Silésie.—Leaves undulated on the margin, pale green, slightly tinged with reddish brown on the outside. The head is very large, moderately firm, and of very good quality, if its growth is not checked by drought. Seeds white.

12. **IMPERIAL**—syn. Union, Impériale, Grosse Allemande.—Very large, and tolerably close-hearted, but it is not equal in quality to some of the preceding. Seeds white. The Laitue Turque is very similar to this, with the exception of the seeds, which are black.

13. **MOGUL**—syn. Grosse brune paresseuse, Laitue de Hollande, Grosse grise of the Parisian market gardeners.—Leaves large, roundish, wrinkled, grayish green, marked here and there with patches of pale brown. The head is very large and regularly formed, tinged with brownish red on the top; but it is long in forming, and when formed soon runs to seed. It must, therefore, rank as inferior to most of those already described. The seeds are black.

14. **LARGE WHITE CABBAGE LETTUCE**—syn. Late White Cabbage, Saxony, Union, Swedish or Sugar of some, Fine Large Mogul, Princesse, Royale à graine blanche, Blonde paresseuse, Blonde d'été, Jaune d'été.—Leaves smooth, with an even surface; pale green. Heads large, compact, somewhat flattened; it forms rather slowly, but does not run quickly to seed in hot weather. Seeds white. A very good summer cabbage lettuce.

15. **BLACK-SEEDED YELLOW**—syn. Blonde de Berlin, Blonde à graine noire, Royale à graine noire.—Very similar to the preceding, except in the colour of the seeds, which are black.

II.—COS LETTUCES.

16. **WHITE PARIS COS**—syn. Sutton's Superb White Cos, Romaine blonde maraichère, Chicon blond.—Very large, pale green, leaves hooded at the top, so that they close over, and a large heart is blanched without tying. It is very white, crisp, and excellent. It continues growing and hearting for nearly a fortnight after other Cos lettuces sown on the same day commence to run to seed. In a note on this variety, in the *Journal of the Horticultural Society*, vol. vi. p. 26, it is stated, that

“of all the varieties of summer Cos lettuces, this was the largest, the best, and the *longest in running to seed*. It was sown April 10th, and had not commenced to run July 27th, when all other Cos lettuces sown on the same day were showing flower.” It is generally esteemed as the best summer Cos lettuce, and is the sort most extensively cultivated in the neighbourhood of Paris. The seeds are white.

17. **GREEN PARIS COS**—syn. Sutton's Superb Green Cos, Ady's Fine Large Cos, Wellington Cos, Romaine verte maraichère, Chicon vert.—This very much resembles the White Paris Cos, except that it is hardier, and its leaves, till blanched, are of a fine dark green colour. It is very large, and closes in for blanching without tying. The heart becomes white, crisp, and excellent. As regards quality, some prefer this to the White Paris Cos, and it has the advantage of being hardier, an important consideration, especially in a northern climate. It will stand through ordinary winters, with a little protection, in a sheltered situation. It is nearly as hardy as the Brown Cos, and should be substituted for that sort where its colour is objected to. The seeds are white.

18. **COCK'S HARDY WHITE COS**.—This resembles the White Paris Cos, and equals it in quality; but it is hardier, and better adapted for standing the winter, and for that purpose it is valuable.

19. **EARLY GREEN COS**—syn. Egyptian Cos, Egyptian Green Cos, Early Egyptian, Brighton Cos, Brighton Green Cos.—Leaves pointed, very dark green. Heart blanches very crisp, but requires to be tied. It is not so large as the Green Paris Cos, but is rather earlier. A very good and tolerably hardy sort.

20. **BLACK-SEEDED ALPHANGE COS**—syn. Alphange blonde à graine noire, Magnum Bonum of some.

21. **WHITE-SEEDED ALPHANGE COS**—syn. Alphange blonde à graine blanche.—These two are very much alike, except as regards the colour of the seed. They are very large; leaves broad and thick, the outside ones a little tinged with brown; they require to be tied for blanching. The heart then becomes very good, though not so crisp and excellent as in the Paris Cos. The plants have the merit of remaining long without running to seed.

22. **BROWN COS**—syn. Brown Bath Cos, Bath Cos, White-seeded Brown Cos, Sutton's Berkshire Brown Cos, Wood's Improved Bath

Cos.—A very hardy sort of Cos, and of all others the best for standing the winter. It grows to a large size, hearts well with the assistance of a little tying up, and is crisp and excellent. The leaves are brown, and, notwithstanding the good properties of the variety, objections are made to it on this account, any shade of green being more pleasing in a vegetable. But though the outside leaves are brown, the heart, with a little attention, can be rendered beautifully white, with the exception of a slight tinge of pale pink at the mid-rib, and which contrasts well with the whiteness of the rest of the leaf. It is better to grow and blanch well a good heart, so that it will still be a large one after all leaves of an objectionable tinge are removed, than to endeavour to produce only small cabbage lettuces, consisting of little else but tough green outside leaves. There can be no question as to the superiority of the former; and we think the Brown Cos would get into general favour if well cultivated, properly blanched, and then fairly tried.

23. ARTICHOKE-LEAVED—syn. Romaine à feuilles d'Artichaut.—Leaves long, upright, narrow, much cut or jagged, so that they somewhat resemble the leaves of the artichoke; they are numerous, forming a thick tuft; the outside ones are brownish green, the heart-leaves blanch white, some of the mid-ribs being slightly tinged with pale crimson. It is very tender, crisp, and excellent, even without tying, but by this it is much improved. This variety is very hardy; and as it is long in running to seed, it is well adapted for late autumn and early winter use. It will continue to furnish excellent salads when the other summer-grown Cos lettuces are either destroyed by frost, or have acquired a bitterness that renders them unfit for use. The seeds are black, and for late produce should be sown in June and July.

24. SPOTTED COS—syn. Aleppo, Bloody, Romaine panachée, Sanguine.—Of medium size. Leaves spotted and streaked with red. The heart blanches tender, but the plant requires tying up. Seeds white; there is also a spotted variety with black seeds.

The varieties above described are much more numerous than will be required for any private garden; but some prefer one kind, and some another, and therefore it is well to have plenty for choice. Moreover, by trying a number of varieties, some may be found better

adapted for particular circumstances of soil, climate, and means of protection, than others. For example, one person may have it in his power to grow a fine sort of Cos lettuce in winter, whilst another may only have the means of growing the Hardy Hammersmith.

First main crop of Cos Lettuces in the open ground. These lettuces are produced, to come in for use in high perfection in the early part of summer, earlier or later according to the season. Large tracts of market garden grounds are planted, and the crop in almost every instance is so uniformly excellent, that we cannot do better than detail the mode for imitation; for on a small scale in private gardens, it may be perfectly well and very advantageously imitated. Preparation should be made as early as the end of July or beginning of August. About that time some convenient open space sheltered from the north and north-east, and having a hard surface, should be selected, and the dimensions of a one, two, or three-light frame, according to the supply required, should be traced out. If all go on well, it may be observed, 1000 plants fit for planting out may be reared in each light; but allowance should be made for accidents. The frame should either face the south-east, south, or south-west, but preferably the sun at about eleven A.M., as this aspect will admit of the sun's rays drawing off the damp at an early period of the day. When the position is traced out, the bed may be formed; it should consist of stable litter, shaken and beaten with the fork, so as to be as equally compact as possible. It should be about 2 feet high at back, and not more than 1 foot at front, for it is necessary that the sashes should have a steep slope, in order that the moisture may run down the glass rather than drip on the plants, for if it do they would damp off. The object of putting up the bed so long before the time of sowing, is to allow the litter to subside, and the fermentation to cease, for its stimulus is not required. The soil for the frames should be got ready in the first week of October. It must be light, but it need not be very rich. Leaf-mould is very good, and it may be mixed with a little sand. It may be put on 6 or 7 inches thick; at all events, it should be filled in to within $4\frac{1}{2}$ inches of the sashes. From very long experience, the best time for sowing is the 11th of October, or as near as possible to that day. Sowings made sooner or later than this for the crop under consi-

deration may occasionally succeed better than those made at the period above indicated; but they are the exceptions, this the rule. After sowing, the sashes should be kept on till the seeds begin to germinate. When this takes place, air ought to be freely given, and the sashes may even be drawn quite off in favourable weather, during the day; and when put on at night, and even in wet weather, they should be raised so as to admit plenty of air, but of course less in severe than in mild weather; and if very severe, the frames should be kept close. If it should happen that the plants get frozen, the frames must be kept close till the plants are fairly thawed. If a sash be lifted up when the plants beneath it are stiff with frost, they are almost sure to damp off; therefore great care must be taken in giving air in such cases. The external air should not be admitted in large quantity when it is much warmer than the soil in the frame; for whatever the temperature of this may be, the plants will be of nearly the same temperature. Therefore, if the one be colder than the air, so will be the other likewise, and on both the moisture of the warmer air will be condensed, and the plants will be liable to damp off in consequence. Very little watering will be required. When the plants are up, and can well be laid hold off, they should be thinned by removing all the weakest, so that those left may be about $1\frac{1}{2}$ inch apart. The aim should be to keep the plants merely growing till the days begin to lengthen; therefore, during December, if occasional sunshine should throw heat into the frame, the stimulus must not be taken advantage of. On the contrary, additional air should be given, so that the sun-heat may escape rather than accumulate to stimulate the plants. In January, if the weather be favourable, a more active growth should be encouraged; but it is still desirable that it should be steady. If the plants are backward in growth, the directions for giving abundance of air may be somewhat modified, and less air may be given in January, and till near the time of planting out, when the plants should again be freely exposed. In January, the weather is sometimes unusually mild, with a south-west wind, but wet and sunless. There is then danger of the plants drawing up tall and weak before they can be planted out. In this case, whilst the sashes must necessarily be employed as protection from wet, yet they should be re-

moved so as to allow a free circulation of air whenever it is possible to do so with safety. In mild winters, planting out is done to a considerable extent near London in January. In private gardens a portion may then be planted out in a sheltered situation; but the preferable time is February. A great object is to get the plants well rooted before the dry March winds set in. The ground should accordingly be prepared before that time. It should be light and rich, and it ought to be well manured, not at top but below the plants. The best kind of manure is fresh littery stable dung. It is, however, desirable that the littery portion should be moistened with the manure water of the stables. The dung should be spread equally over the surface to a good thickness. The ground should then be lined off for 2-foot trenches; the first trench being taken out one spade deep, the dung on the second space of 2 feet should then be turned into the bottom, and covered with a spade deep of soil from the second trench, and so on, till the whole piece of ground be worked over. The littery manure will thus be about 1 foot below the surface, where it will act as drainage, preventing any stagnation of water at the roots of the plants, whilst its ammonia will stimulate their growth. They are usually planted out at 1 foot apart each way. In planting at this early season, the dibber, in closing in the soil, should be inserted on the *south* side of the plant. There have been instances in which it has been observed, that every alternate row of plants had perished, and on examination, it was found that this was the row in planting which, the dibber had been inserted on the north side of the plants; whilst in planting the next row the dibber had been inserted on their south side, and these plants were all safe. The planter should therefore proceed from the west to the east end of the row, and then, instead of turning to the adjoining row, and working from east to west for the sake of greater expedition, he should return again to the west end. The dibber holes will thus be always on the south side. This may seem a trifling matter, but when the loss of half the plants in a plantation is taken into account, besides the labour of replacing them, and perhaps the difficulty of doing so owing to a scarcity of plants, the circumstance becomes of such importance as to claim attention. The holes left by the dibber should, however, be filled up as soon as possible after planting, either

with a hoe or piece of wood; indeed, it should be done tolerably well by the planter at the time, but it cannot be then done perfectly where several acres have to be planted with upwards of 43,000 plants in each; besides, the soil turned loosely into the dibber hole will subside in a few days; the hollow formed in consequence ought, however, to be again filled level with the surface. After planting, although there may be no weeds, yet the ground should be frequently hoed, or otherwise stirred and kept loose. This greatly encourages the growth of the plants, and crushes slugs and other enemies of the crop. Of course the ground should not be worked or trodden upon when it is not in tolerably moist condition.

The White Paris Cos, as was observed in describing that sort, does not require tying up; nevertheless, like all other sorts, it is tied up before being sent to market, where, if seen untied, they would not sell so readily. It is therefore put round, if only a day or two before the lettuces are taken up, as is sometimes the case if the demand is brisk, or if wet weather prevent the tying being performed at an earlier period. As regards blanching, little effect can be produced in so short a time by the tying; but it is of some use in keeping the heads compact, and rendering them less liable to be bruised from packing and carriage. The plants should be tied up when they are perfectly dry; strips of matting are used for the purpose, and in applying it the leaves should first be gathered regularly together, but not tightly, and the matting is then put round a little above the thickest part of the head.

Having followed up the management of the principal crop, from the formation of the seed-bed till it attains perfection, we shall now return to the subsequent sowings.

A succession should be sown in frames, in the same manner as already described, but at an interval of not less than three weeks after the first sowing, that is, not before the 1st of November. If there are not at least three weeks between the first and second sowings, no succession will be insured; for if the second should start more favourably than the first, the crop from both will become fit for use at nearly the same time. About the 5th of November will be a good time for the second sowing. The plants should be managed as directed for the previous one.

For a third succession, sow again in frames

about the end of January, or first or second week in February; and a small sowing should be made at the end of that month, in light rich soil, in a frame placed on the ground; or the plants may be sheltered with hand-glasses at night, and also during the day, but with plenty of air.

As soon in March as the ground is in good condition, and the weather favourable, sow, on a south border, or in some warm situation, some of the best varieties of both Cos and cabbage lettuces. In April, the different varieties of summer lettuces should be sown on a border in front of a west aspect wall. In May and June, successional sowings may be made in any open situation, or on a border in front of an east aspect, that being cooler than the west aspect border, and at this hot period of the season coolness is desirable for this crop. Sowings of the Green Paris Cos, and of the Artichoke-leaved, should be made in the end of June, and in the middle of July, for use in autumn and in the early part of winter.

Between the 15th and 20th of August, sow some of the Green Paris Cos, Brown Cos, Brown Dutch, and more especially the Hardy Hammersmith, as it is most to be depended on in case of a severe winter. They may be planted on the sides of ridges, which may be formed obliquely, across a sheltered border in front of a wall, hedge, or boarded paling, facing the south. If the ridges are made from south-east to north-west, and planted with lettuces on both sides, those on the north-east will have some portion of the sun's rays to dry the foliage in the morning; and those on the other side, facing the south-west, will receive nearly direct the sun's rays at the hottest time of the day. The Hardy Hammersmith may be planted on these ridges at the distance of 6 or 8 inches apart. In planting at the bottom of walls, care should be taken not to plant where the drip falls from the coping. This can easily be discovered by a small track made in the soil by the drops after heavy rain.

Another sowing of the same kinds, or of similar hardy ones, should be made towards the middle of September, for use in spring, if they should happen to survive the winter.

Lettuces are sometimes required for cutting young, or when about 2 inches high; these are termed by the French *Laitues à couper*. The small early sorts, such as the Hardy Hammersmith and Black-seeded Gotte, are preferred

for this purpose; but any sort that is green or pale green, and not brown or otherwise coloured, will do. They should be sown in the open air once a-week, or every ten days, from April throughout the season. In winter they are best raised in heat. They should be sown rather thickly, in drills 6 inches apart.

Lettuces sown in the open border, as well as those sown in frames, should be regularly thinned; and this should be done before the plants crowd or draw each other. Plants that, for want of this attention, are drawn up weak and slender before planting out, never make such full succulent heads as those that, by proper thinning, have a shorter, but comparatively thicker stem. Transplanting from the seed-bed should take place as soon as possible after the plants have made two or three leaves. In planting, the dibber should not be strongly pressed against the roots; otherwise, being tender, they are apt to be bruised. Cloudy weather should be preferred for the operation. The ground should be made fine, and for the summer crops it cannot be too rich; in winter, the plants will stand better in soil that is rather poor; but when vegetation commences to be active in spring, manure water will greatly promote their growth. Instead of planting with the dibber, where the plantation is not of such extent as to render the expense of labour a great consideration, it is better to make a small perpendicular cut with the spade by the side of the line, and against the face of this cut, to spread the roots with the right hand, whilst with the other the plant is held so that the soil cannot get into the heart. After planting the first row, another foot wide of the ground should be dug and levelled, and the line stretched at the proper distance from the first row. That row should then be watered through not too coarse a rose, and not merely at the root of each plant, but all along the row. A cut should again be made by the line, and the second row planted in the manner directed for the first. Proceeding thus till as many rows are planted as may be necessary, the ground will be left even, untrodden, and of equal looseness. If subsequent waterings be necessary, the whole surface should be watered, and at every time copiously enough to moisten quite as far as the roots extend.

To save Seed.—This should be done from the plants sown in autumn or in spring. The finest specimens should be selected, avoiding,

however, those that show a disposition to run quickly to seed. Those that heart readily, and yet are slow to run up, are to be preferred. Care should be taken that no two different varieties be allowed to seed near each other, in order that the sorts may be kept true. The seed which ripens first on the plant is the best; therefore it should be secured, rather than wait for the general ripening. The branchlets which first ripen their seeds should be cut off, and laid on a cloth in the sun. Or, when the forward portion of the seed is as near maturity as it will safely bear, without shaking off, the plants should be carefully pulled up, and placed upright against a south wall, with a cloth under them, to perfect their ripening. The seed will keep three or four years; but in any case none should be depended on without trial. Plants from seed two years old heart more readily than those from one-year-old seed.

Insects, &c.—Several insects attack the lettuce. The maggots of the spotted crane-fly (*Tipula maculosa*, Hoff.), and the caterpillars of the garden-swift (*Hepialus lupulinus*), of the heart and dart-moth (*Agrotis exclamationis*), and those of the common dart-moth (*A. segetum*), soon make their presence known by the extensive ravages which they commit. They cut through the tap-root at a little below the surface, and if allowed to remain, soon perpetrate the like mischief on fresh victims. The true wireworms, which are the larvæ of various species of *Agriotes*, sometimes do considerable damage by eating the roots and even the stems. A new enemy, in the shape of a species of *Aphis*, attacking the roots and causing the plants to droop and die suddenly, has also made its appearance of late years. The leaves of lettuces are sometimes injured by the caterpillar of the cabbage-moth (*Mamestra brassicae*), and the maggots of the lettuce-fly (*Anthomyia lactucae*) prove very destructive to the seed crop, sometimes causing its entire failure by devouring the seeds.

LIQUORICE (*Glycyrrhiza glabra*, L.—*Dialophia Decandria*, L.; Leguminosæ, D. C.; Fabaceæ, Lind.) is a perennial plant, a native of the south of Europe. It has a fleshy root, which runs deep into the ground, and a stem rising from 3 to 5 feet high, and clothed with dull green pinnated leaves. The sweet mucilaginous juice, extracted from the roots by boiling, is much esteemed as an emollient in colds. Large quantities are grown for the

use of druggists, in the vicinity of Mitcham, in Surrey, to which place its cultivation, on an extensive scale, is almost entirely confined. A plant or two is kept in most gardens.

Liquorice succeeds best in deep, rich, and rather sandy soils, or in an alluvial one. The ground should be heavily dunged the year previous to planting, in order that the manure may be completely decomposed; and it should either be trenched 3 feet deep in autumn, laid in ridges, and allowed to remain in that state till spring; or it may be trenched immediately before planting. The former method is the preferable one. Liquorice is propagated by portions of the creeping stem, commonly termed the creeping root, from 4 to 6 inches in length, each having two or three buds. These having been prepared, should be planted in February, or early in March, in rows 3 feet apart, and 18 inches from each other in the row, covering with earth to the depth of 2 or 3 inches. Every year in November, when the sap has gone down, and the leaves have turned yellow, the old stems should be cut down with a pruning-knife to the level of the ground. At this time also the creeping stems ought to be forked up, and cut off close to the main stems, and preserved in sand or in heaps covered with straw and earth, for future plantations. The ground between the rows should be forked occasionally, and kept free of weeds. The roots will be ready for taking up three years after planting; this should be done in winter, after the descent of the sap. A trench about 3 feet deep must then be cast out, and a rope being fastened round the top, the roots should be pulled up, after which they may be stored in sand for use; or if there is a large quantity, they may be kept in pits like potatoes.

LOVE APPLE. See TOMATO.

MARIGOLD, or Pot Marigold (*Calendula officinalis*, L.—Syngenesia Polygamia Necessaria, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a hardy annual, a native of the south of Europe. It is cultivated in the kitchen garden for its flowers, which are put into soups.

The varieties cultivated for use are:—

1. COMMON, OR SINGLE-FLOWERED MARIGOLD.
2. DOUBLE-FLOWERED MARIGOLD.

It is raised from seed, which should be sown in March or April, in shallow drills 1 foot apart. When the plants are 2 or 3 inches high, they should be thinned out to 10 inches or 1 foot apart. The plants from these sow-

ings will flower in June, and continue flowering till September. The flowers may be gathered when full-blown, dried in the shade, and stored for winter and spring use.

MARJORAM (*Origanum*, L.—Didynamia Gymnospermia, L.; Labiatae, D. C.; Lamiaceæ, Lind.) is cultivated for the aromatic leaves, which are used both in a green and in a dried state for seasoning soups, and other dishes.

Four species are cultivated:—

1. COMMON MARJORAM.
2. POT MARJORAM.
3. SWEET, OR KNOTTED MARJORAM.
4. WINTER SWEET MARJORAM.

The second and third sorts are those generally cultivated.

1. COMMON MARJORAM (*Origanum vulgare*, L.) is a perennial plant, a native of Britain, growing naturally in thickets. It is seldom cultivated; but if required, may be raised from seed sown in spring, or it may be propagated by parting the roots in spring or autumn. Plant 1 foot apart in any soil that is not very moist.

2. POT MARJORAM (*Origanum Onites*, L.) is a perennial plant, a native of Sicily. It flowers from July to November, but seldom ripens its seed in England. It is propagated by dividing the roots in March or April, or by slips or cuttings taken off in summer and planted in a frame or under a hand-glass; when well rooted they may be planted out. It prefers a light and rather dry soil, and a warm situation. It may be planted in rows 1 foot apart, and 10 inches from plant to plant in the row.

3. SWEET, OR KNOTTED MARJORAM (*Origanum Majorana*, L.) is a tender biennial, a native of Portugal. In this country it will not stand the winter in the open ground; it is therefore treated as an annual. It is raised from seed, sown broadcast on a south border, in the beginning of April. When the plants are about 2 inches high, they may be transplanted into rows 9 inches apart, and 5 or 6 inches asunder in the row. Or it may be sown in shallow drills 9 inches apart, thinning out when the plants are about 2 inches high, to 6 inches asunder in the rows. Some may also be sown in March, on a slight hot-bed, either to remain for early use, or to be planted out at the above distances.

The flowers appear in June and July, and are collected into roundish close heads, resembling knots, from which circumstance it is frequently called knotted marjoram. The seed

seldom ripens in Britain, and is obtained from the Continent.

4. WINTER SWEET MARJORAM (*Origanum heracleoticum*, L.) is a hardy perennial, a native of the south of Europe. The flowers appear from June to November, but the seeds seldom ripen. It succeeds best in a dry soil, and is propagated by dividing the roots in spring or autumn, and planting the divisions 10 inches apart, in rows 18 inches asunder.

Tops of all the sorts of marjoram should be cut when coming into flower, and dried in the shade, for winter and spring use.

MINT (*Mentha*, L. — *Didymia Gymnospermia*, L.; *Labiatae*, D. C.; *Lamiaceae*, Lind.) — Three species of this are cultivated:—

1. COMMON, OR SPEAR-MINT.
2. PEPPERMINT.
3. PENNYROYAL.

1. SPEAR-MINT (*Mentha viridis*, L.) is a hardy perennial, a native of Britain. The tops are used in soups and salads, in sauce for lamb, and they are boiled along with pease and other vegetables. It prefers a moist soil, but will grow in almost any soil and situation. It is easily propagated by dividing the roots in February or March, planting the divisions in rows 9 inches apart, and covering the roots with soil to the depth of 2 inches. It may also be propagated by offsets at the same periods, and by cuttings about 6 inches long, taken off in summer, planted about 3 inches deep, and watered till they take root. Every year at the approach of winter, the old stems should be cut down, and the beds cleaned and covered with mould to the depth of 2 inches. In some soils, fresh plantations require to be made every three or four years; in others only after the lapse of several years. When the plants are coming into flower, a quantity of tops should be cut and dried for use in winter.

2. PEPPERMINT (*Mentha piperita*, L.) is a hardy perennial, a native of England. It is principally cultivated for the distillation of the well-known cordial that bears its name. It requires the same soil and treatment as the preceding species, and is propagated in the same way and at the same times.

3. PENNYROYAL (*Mentha Pulegium*, L.) is a hardy perennial, a native of Britain. It succeeds best in a moist loamy soil, and is easily propagated by offsets, or by dividing the roots in September, March, or April. Plant in rows 1 foot asunder, and 6 inches from plant to plant in the row, and water at planting.

MOREL (*Morchella esculenta*, Pers.—*Cryptogamia Fungi*, L.; *Fungi*, D. C.; *Alliance*, *Fungales*, Lind.)—The morel is an edible fungus, a native of Britain, where it is found growing in orchards, woods, and moist pastures. It is said to occur most abundantly in places where wood has been burned, or charcoal made. It rises to about 4 inches in height, and consists of a smooth white cylindrical stem, and a hollow spherical cap adhering to the stem by its base; pale brown, or gray in colour, and marked with deep pits all over its surface. The morel is used either fresh or in a dried state, in gravies, stews, &c. It usually makes its appearance in spring or early in summer. It should not be gathered when wet, otherwise it will not keep well. It has not as yet been subjected to cultivation, but it is probable, that if morels commencing to decay, and the soil about them, were collected, and placed under different circumstances of soil, heat, and moisture, the attempt might prove successful, and a proper mode of cultivation be arrived at.

MOUNTAIN SPINACH. See ORACH.

MUSHROOM. See FORCING.

MUSTARD (*Sinapis alba*, L.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.) is a hardy annual, a native of Britain, where it is found in fields and waste places. It is only used, generally along with cress, as a small salad, for which purpose it is cut in the seed-leaf. It is raised from seed, which should be sown every week or ten days throughout the year, either in the open ground or in heat, according to the season. The sowings in the open ground may be commenced about the middle of March, and given up about the middle of October, earlier or later, in both cases, according to the greater or less mildness of the season. The ground where it is to be sown should be light, rich, and raked very fine; for the early and late sowings a warm spot should be selected; for those made in the heat of summer, a shady situation must be chosen; at other times any open compartment with good soil will do. It should be sown thickly, in shallow drills 6 inches apart, and only slightly covered with earth, after which the surface should be pressed smooth with the back of the spade, so that there may be no roughness to interfere with the cutting. With the exception of watering the seed-bed and the young plants in dry weather, no further culture is necessary. In gathering, the plants

are cut over by the ground; if allowed to remain they will put forth leaves a second time, but those first produced are greatly to be preferred.

The Black Mustard (*Sinapis nigra*) is almost entirely cultivated for the seed, which, when ground, constitutes the table mustard. Its leaves are sometimes, though rarely, grown as a small salad; the culture of both species for this purpose is the same.

NASTURTIUM, or Indian Cress (*Tropæolum*, L.—*Octandria Monogynia*, L.; *Tropæolæ*, D. C.; *Tropæolaceæ*, Lind.)—Of this, two species are cultivated:—

1. **LARGE NASTURTIUM** (*Tropæolum majus*, L.)

2. **SMALL NASTURTIUM** (*Tropæolum minus*, L.)

They are both natives of Peru, and perennials in their own country, but are treated as annuals in this. There are varieties of both species with double flowers, but these, requiring the protection of a greenhouse, are chiefly cultivated for ornament; there is also a variety of *T. majus* having brownish purple flowers. The leaves, young shoots, and flowers are frequently eaten in salads. The flowers are used as a garnish; and the young flower-buds and fruits, gathered when green, are pickled in vinegar, and employed instead of capers, to which they are by some considered superior. For this purpose the second species is preferred, as it produces more flowers and fruits than the other, and requires no support.

These plants succeed best in a light rich soil, with a warm aspect. They are raised from seed, which should be sown in the end of March or in April, depositing the seeds about 4 inches apart, in a drill 1 inch deep. As the plants of the first species climb to the height of 6 or 8 feet, the seed should be sown in front of a paling or other object by which they may be supported; or the sowing may be made in the open ground, and pea-sticks placed for the plants to climb upon; the distance, in this case, between the rows, if more than one be sown, may be 3 feet.

The plants should be frequently watered in dry weather, and will require a little training at first, beyond which no other culture is necessary.

NEW ZEALAND SPINACH (*Tetragonia expansa*—*Icosandria Pentagynia*, L.; *Ficoideæ*, D. C.; *Tetragoniaceæ*, Lind.) is a hardy annual, a native of New Zealand, whence it was in-

troduced into this country, in 1772, by Sir Joseph Banks. Though inferior to spinach it forms a good substitute for that vegetable, especially in the hot dry months of summer, when the common spinach runs so quickly to seed, that even with frequent sowings it is sometimes impossible to gather a good dish. On the other hand, the New Zealand spinach, under the same circumstances, always produces, when properly cultivated, an abundance of succulent leaves. It is therefore advisable to have a few plants of it as an auxiliary, in case of the partial failure of any of the summer sowings.

It is raised from seeds, which are excessively hard, and therefore should be steeped for twenty-four hours before sowing. It should be sown in March on a gentle hot-bed, placing the seeds 3 or 4 inches apart. When the seedlings have grown to the length of 2 or 3 inches, they may be lifted, and planted singly in small pots, which should be placed under a frame till the middle or end of May, when the young plants may be planted out. This should be done in a light rich soil, with a southern aspect. The distance between the plants in the row may be 3 feet, and between the rows from 4 to 6 feet. If planted on a border sloping towards the south, the plants should not be less than 18 inches from the path, as they will incline to grow most in that direction. Water should be given at planting, and afterwards all the care they will require is confined to watering frequently in dry weather. In gathering, the young leaves should be pinched off; abundance of fresh ones are produced throughout the summer and autumn. Seed may be saved by placing a plant or two in poor soil, in lime rubbish, or by training them against a wall. In warm seasons, however, it ripens its seeds in the open ground.

NIGELLA SATIVA, L. (*Polyandria Pentagynia*, L.; *Ranunculaceæ*, D. C.; *Ranunculaceæ*, Lind.), is a hardy annual, a native of Caudia and Egypt. Its aromatic seeds are employed in French cookery under the name of *quatre-épices*. It requires a light soil and a warm aspect. It is raised from seed, which should be sown in April, in drills 1 foot asunder. The sowing should be made where the plants are to remain, for they seldom grow well when transplanted. When the seedlings are 2 or 3 inches high, they may be thinned out to 6 inches apart in the rows. After this no further care is necessary, with the exception of

keeping the ground clean and watering frequently in dry weather.

ONION (*Allium Cepa*, L.—Hexandria Monogynia, L.; Liliaceæ, D. C.; Liliaceæ, Lind.)—The onion is a hardy biennial, by some supposed to be a native of Africa; but the date of its introduction, and its native country, have not been ascertained. The uses of the onion are universally known, and few plants have such a wide range of cultivation; for it is grown from the tropics to the coldest verge of the temperate zone. The leaves and roots are of an annual nature, in as much as they die in the course of a single summer after perfecting a bulb; the latter, however, is biennial, and after a temporary rest it has the power of emitting new roots, pushing fresh leaves, and sending up a flower-stalk. In some cases, also, it forms offset bulbs. There are many varieties, all of which are still subject to variation, so that if shades of difference were taken into account, names would be uselessly multiplied. It is necessary, however, to know sorts that are early or late, large or small, mild or strong, and to be able to distinguish such as naturally keep till late in spring from those that decay even before winter. All this it is presumed may be known from the following brief descriptions of the principal sorts at present in cultivation. These are:—

1. **SILVER-SKINNED**—syn. Large Silver-skinned, White Egyptian, Large White, Oignon blanc gros.—Middle-sized, round or flat, skin thin, white, and shining; when it splits, as it is apt to do when the bulb is nearly ripe, or when otherwise removed, the layer beneath it is of a beautiful clear white, striped with fine green lines, extending from the base to the neck. It does not keep long, but is much esteemed and cultivated for its mild quality, and for pickling. In pickles, its white colour in contrast with the fine green veins or lines gives it a very agreeable appearance. For pickling, the seed should be sown thickly in March; it should only be slightly sprinkled over with fine soil, and the ground should afterwards be rolled. If the seed is covered more deeply, the bulb, from not being quite on the surface, has a larger root and a thicker neck, so that it loses its finely rounded form, and is, moreover, less compact.

2. **EARLY SILVER-SKINNED**—syn. Oignon blanc hâtif.—A variety differing from the preceding in being smaller and earlier; in other respects, the two perfectly resemble each other.

Esteemed for its earliness, and for being well adapted for pickling.

3. **WHITE NOCERA**—syn. Oignon blanc de Nocera.—This is a variety of the Early Silver-skinned. It is very small, occasionally roundish, but generally oblate; skin white, beneath it the layers are striped with bright green lines. The leaves are very small, sometimes the bulb has only a single leaf, frequently no more than two; and if there are more than four, the plant has not its true character. It is the smallest and earliest variety known, and is excellent for pickling.

4. **SPANISH**—syn. White Spanish, Reading, White Reading, Portugal, White Portugal, Evesham, Cambridge, Sandy, Oignon d'Espagne.—Very large, flat; skin loose, pale brown, falling off spontaneously, exhibiting the next coating, which is greenish white. Flavour particularly mild. This sort is not a long keeper, but is much esteemed for its quality, and is one of the best for early winter use.

5. **LISBON**—syn. White Lisbon, Early Lisbon, Florence, Oignon blanc de Florence.—Large, globular, neck rather thick; the skin smooth, thin, clear, and white. A late but hardy sort; if sown in August it affords a good supply of young onions for spring salads; or it may be transplanted from the autumn beds in April, and if so, large onions will be formed towards the end of summer.

6. **TWO-BLADED**—syn. Double Tige.—This sort derives its name from the small bulbs having, in general, only two leaves; the larger ones have more, rarely, however, exceeding four; but unless by far the greater portion of the crop have only two leaves, either the seed or the cultivation is at fault. The bulbs are small, flat, light brown, very firm, and attain maturity very early.

7. **STRASBURG**—syn. Flanders, Dutch, Essex.—Large, varying in shape from flat to globular or oval; outside coating brown, of firm texture; divested of this the colour is reddish-brown, tinged with green. Flavour strong. Being a hardy sort, and a good keeper, it is very generally cultivated. Where but few varieties are grown, this should be one of them.

8. **DEPTFORD**.—This can only be considered, at most, a variety of the preceding. It sometimes agrees with the description of that sort; occasionally it has a pale-brown skin, without any tinge of red, and when this is the case its flavour is milder than that of the Strasburg.

9. **WHITE GLOBE**.—Under this name a sub-

variety of the Strasburg is now cultivated, and much approved of by the growers near London. It is rather large and firm; general form roundish, but inclining to taper abruptly towards the neck, and also to the root, which is an advantage, as the hard portion in connection with the root is somewhat prominent, and can be cut off without entering deeply into the softer substance of the bulb. It is of excellent quality, and a good keeper.

10. BROWN PORTUGAL—syn. True Portugal, Brown Spanish, Oporto, Lisbon, Viana, Large St. Ubes, Catalogne, Cambrai, Oignon jaune des Vertus.—Large, roundish or flattened; skin yellowish-brown on the outside, next interior layer not tinged with red. Of excellent quality and a good keeper.

11. YELLOW DANVERS—Oignon jaune de Danvers.—Middle-sized, roundish oblate, firm, with a very slender neck; skin yellowish-brown. A new and very fine variety, as early as the Silver-skinned, or even earlier, according to the excellent authority of M. Vilmorin of Paris, by whom it was sent to this country. It appears to be a much better keeper than the Silver-skinned.

12. BLOOD-RED—syn. French Blood-red, Dutch Blood-red, St. Thomas', Oignon rouge foncé.—Middle-sized or rather large, flattish; skin dull red, the coating next below it glossy and very dark red. The internal layers are palest at the base, and, except at the top, they are only coloured on their outsides; each layer is paler than the one which surrounds it till the centre is reached, which is white. Of all others, this sort is the strongest flavoured; it keeps remarkably well.

13. PALE RED—syn. Amiens, Rouge pâle, De Niort.—Middle-sized, roundish, flat on the under side, but the upper side is not so flat as the Blood-red, of which this sort may be considered a variety. It is paler than that sort, and not so strong flavoured.

14. JAMES' KEEPING—syn. James' Long Keeping, Oignon poire, Oignon pyriforme.—Large, pear-shaped; skin brown, the coating next under it reddish-brown. Flavour strong. This variety is much esteemed for its long and sound keeping. It is said to have been originated by Mr. James, a market gardener in Lambeth Marsh. It is believed that a similar variety, or one identical in character, could be raised by selecting for seed those amongst the Blood-red onions which approach to the oval or pear-shaped form, and which are of

the palest colour. By selecting successively from the previous selection, a variety having the characteristic appearance and properties of James' Keeping will be obtained; and as the varieties of the onion, including the one in question, are apt to vary or degenerate, recourse may be had to this mode in order to obtain one having the desirable qualities of the original James' Keeping.

The Arnstadt Pear-shaped Onion—syn. Oignon poire d'Arnstadt—is considered by M. Vilmorin to be a large variety of James' Keeping.

15. MADEIRA—syn. Oignon de Madère, Ro-main, Bellegarde.—Very large, roundish obovate, with a thick neck; skin reddish brown, the layer under it pale red. A soft mild onion, but does not keep long. On account of its large size and mild flavour it is well deserving of cultivation for autumn and early winter use.

16. TRIPOLI—syn. Besagnina.—Very large, tapering sometimes abruptly from the middle to the neck, and almost equally so to the root; colour light reddish brown, beneath the skin pale brownish red tinged with green. It is of a soft nature, and does not keep long, but whilst it lasts it is much esteemed on account of its mild quality.

17. FUSIFORM ONION—syn. Druses Onion, Oignon fusiforme, Corne de bœuf.—Large, from 6 inches to 1 foot in length, bent and tapering like the horn of an ox. A singular variety, but it wants compactness and keeps badly. On the whole, it is more curious than useful.

18. UNDER-GROUND ONION—syn. Potato Onion, Oignon Patate, Sous-terre.—This forms a number of bulbs on the parent root beneath the surface of the ground, and by means of these it is propagated, and in this way an abundant supply may be insured, although the sorts usually raised from seed should either wholly or partially fail. Or if other kinds of onions do not keep well, as is frequently the case, the Under-ground onion will afford a supply before the others are fit. It is very prolific. Maher states (*Horticultural Transactions*, vol. iii. p. 305), that from sixty bulbs, planted in February, he obtained 360 in the July following. In the west of England this sort is planted on the shortest day, and taken up on the longest. They do not keep in good condition for use later than the beginning of February, but by removing the soil, so as to leave only the fibres in the ground, and the growing cluster exposed, they keep much better.

19. TREE ONION—syn. Bulb-bearing Onion, Egyptian Onion, Oignon d'Egypte, Oignon bulbifère, sometimes also called the Rocambole Onion, but it must not be confounded with the true rocambole (*Allium Scorodoprasum*).—When the stalks of the Tree onion are allowed to run up, they become viviparous, small bulbs instead of flowers being formed along the sides at the top. A few offset bulbs are also formed under ground, and by these, but chiefly by the little bulbs on the stem, the variety is propagated. It cannot be considered a useful sort except as regards the stem-bulbs, which are excellent in pickles, and for which, on account of their very small size, they are well adapted.

20. WELSH ONION—syn. Ciboule.—This is the *Allium fistulosum*, L., an herbaceous perennial, a native of Siberia, and, consequently, very hardy. The French have two varieties—the white and the red. It is quite distinct from the common onion, inasmuch as it never forms a bulb; its roots are long and tapering, with strong fibres, and its stems and leaves are hollow. Its principal use is for sowing in the end of July, or beginning of August, to furnish young onions for salads early in spring. Being very hardy, some of it should be grown for a supply, in case the common onion should be cut off by a severe winter.

Soil.—Onions succeed best in an open situation, and in a rich substantial loam, rather light than strong. Such a soil is not, however, always at command; nevertheless, good crops of onions are obtained from soils of very different texture and quality, by the aid of suitable manures, and by judiciously varying the modes of cultivation, according to circumstances. If the soil is too strong, it should be corrected by proper admixtures; or if that cannot be done, it is possible, in most cases, to pulverize and otherwise ameliorate soil that is too adhesive by trenching, digging, and exposure to the weather. For the spring crop, the ground should be ridged up before winter, as roughly as possible. It should not be disturbed in wet weather, nor whilst it is saturated with moisture; but when it is so dry that its lumps will crumble, rather than stick together, it cannot be too much worked. If, on the contrary, the soil should be too light, means ought to be taken to consolidate it. It should, in the first place, be finely dug, to insure an equal looseness throughout, in order that, by subsequent treading and rolling, it

may be rendered uniformly compact. In dry light soils, good crops are obtained in wet seasons; and it is not merely the quantity that has to be taken into consideration, the quality, in such seasons more especially, is of still greater importance. If onions are not well ripened, they cannot be expected to keep soundly, and of course they will become better ripened in dry light soil, in a cold wet season, than in soil of a contrary description. If circumstances will permit, it is advisable to grow a portion of the crop on warm and rather dry soil, calculated to yield comparatively sounder produce, than can be obtained from ground of a contrary description. The subsoil should be well drained, so as to admit of the rain passing downwards with tolerable facility; and it will generally be in a condition to do this, if prepared as directed in treating of the formation of the garden, so that double digging will be sufficient. If not so prepared, and if the stratum next the subsoil is too retentive, the ground should be sub-trenched. When this is done there will be a free passage for air and moisture throughout the soil. Rain-water will not stagnate, neither will saturation long prevail after the rain ceases; and as soon as the particles of soil are free from saturation, air will, of course, occupy the interstices, whether it be warmer or colder than the soil with which it comes in contact. If warmer, it will deposit moisture on every particle; and of this moisture the spongioles will avail themselves; and growth will be promoted; if colder, it will withdraw moisture from the soil, when the latter contains moisture, and when it does not, of course the air would be comparatively dry; but it is well known that dry and moist air, in contact with each other, will mix; so that, if the soil should be too dry at top and about the roots, the air, from the tendency to a uniform diffusion of its vapour, will be constantly conveying moisture from below upwards. If the soil were so compact as to admit of little circulation of air, except near the surface, the top soil might get too dry, and the plants suffer from want of moisture, although there might be plenty below. Hence the necessity of ascertaining if the soil is sufficiently porous to a good depth, and of sub-trenching when it is not. It is easy to know whether the ground is pervious enough throughout, by observing whether water passes readily downwards, and if it do, air will, of course, circulate freely; if not, trenching must be resorted to.

Manures.—Pigeons' dung has been long very generally employed as a manure for onions, and, from experience, it can be mentioned as one of the best. The dung of other poultry, sheep's dung, and well-decomposed night-soil, are likewise excellent. Pigs' dung is very powerful; it answers well spread on the ground for a considerable time previous to sowing, most of it being removed when the ground is about to be dug for sowing. Strong but well-decomposed farm-yard manure may also be employed; it may either be used fresh, in large quantities, for the preceding crop, or it may be turned into the ground before winter, and thoroughly mixed with the soil previous to sowing. Blood, or slaughter-house offal, formed into a compost with fresh mellow soil, answers well. Guano may be used in the same way, or, largely diluted with water, it may be employed in the form of a liquid manure. Superphosphate of lime is good, especially in moist seasons, and where the soil is damp; and so is bone-dust. In dry soils, liquid manure is advantageously applied. Salt, soot, and lime are useful as manure, and also for preventing the attacks of the onion maggot, and other insects. Charcoal is sometimes sprinkled along the drills with the view of preventing canker. Wood ashes, and charred rubbish, are good along with other manures.

Cultivation of Spring-sown Onions.—The precise time of sowing the main crop of spring onions cannot be stated, for it greatly depends on the state of the weather and the nature of the soil. From the middle of February to the middle of March is the period in which it would be desirable to sow the main crop, if circumstances will permit; but should the ground be either frozen or covered with snow, or saturated with rain, during that period, so that sowing cannot be accomplished before the middle of March, then the first opportunity of the soil being in good working order should be seized. In bad springs, or in very cold situations, it may be as late as the beginning of April before the principal crop can be well got in. The ground having been rendered friable by exposure to the weather, and previously well enriched by manure, it should be dug over in the end of February, or as early in March as the weather will permit. It should not, however, be dug when it is in a wet state, neither should the seed be sown till it is in proper working order as regards dryness. It should be dug in small spits, the full depth of

the spade, but narrow, and each spit ought to be thoroughly broken before another is turned over. The ground should not be made fine merely on the top, leaving the rest of the spit in coarse lumps, but the whole must be thoroughly broken. The surface should be made even and fine in digging, so that the rake shall not be required to regulate the general level, but only to pulverize the soil as it lies. This being done, if the soil is light, it should be trodden or rolled; and heavy soil should also be rolled, if rather dry, at the time, but not otherwise. The whole must then be marked off in 4-foot beds, with 1-foot paths between. Shallow drills should then be drawn along the surface of the bed, not closer than 6 inches apart, but 8 inches will be a proper distance for the medium-sized varieties, whilst for the large sorts a space of 12 inches between the drills may be allowed. The drills cannot be too shallow. If *thick necks* only are desired to be produced, the better way will be to bury the seeds deeply and even, earth up the plants like leeks; but in order to have well-formed, sound-keeping onions, the seed cannot be too near the surface, so long as it is just covered. The seeds, if good—and this ought to be previously ascertained—should be sown thinly along the drills, then covered with a little finely broken soil from the paths, and then the whole surface should be trodden, then smoothed with the rake, or rolled with a roller of greater or less weight, according to the nature of the soil, for the lighter it is the more it should be pressed. In many cases, a roller may not be at command; if so, the surface of the bed should be pressed with the back of the spade. This being done, the line ought to be stretched, and a shallow cut made to mark each of the edges of the bed. A small rake passed along the paths will complete the operation, and the beds will present a finished appearance. Instead of drawing drills, the line may be stretched, and a round straight rod, about $\frac{3}{4}$ inch in diameter, laid alongside of it, then by treading, or otherwise pressing down the rod, a groove of uniform depth, smooth and firm at bottom, will be formed. In this the seeds can be regularly sown, and covered with a little mould. The advantage of this system is, that all the seeds will be near the surface, whereas, when drills are drawn in the ordinary way, some seeds drop into holes, and from being too deeply buried, are apt to produce thick necks.

After sowing, weeding, thinning, and watering are all that is necessary till the crop is mature or nearly so. It will be observed that the plant does not come up with an erect point, but is doubled like a whip, and as it advances in growth the point gets clear of the soil. Very soon after this takes place, the surface of the ground should be hoed, in order to cut up all seedling weeds; and at the same time the onions should be thinned with small 2-inch broad hoes. This first thinning ought to be partial, in case of failure. Hoeing and weeding should be repeated as often as may be necessary, for nothing is more unsightly than weeds rising above the tops of the plants. These, moreover, require all the light that our latitudes afford, and the crop must therefore be injured by the shade of weeds. Although the surface of the soil should be hoed in order to destroy weeds, and although the growth of the young plants may be promoted by the shallow stirring requisite for that purpose, yet the deep loosening of the soil, so beneficial for many crops, is not so for onions. The best formed and soundest bulbs are grown where the surface is rather firm than loose. Shallow hoeing is therefore the best. It has frequently been observed, that where the soil of the beds has been loose, the best onions were those which sprung from seeds accidentally dropped on the paths. The final thinning should be to the distance of from 3 to 6 inches in the row, according to the richness of the soil and the usual size which the variety attains. If some very large onions are required, the drills in one or more beds may be 15 inches asunder, and the plants thinned to 9 inches in the row; and, if the seeds are sown broadcast, each plant should be allowed from 5 to 8 inches square. When the weather is dry, watering is beneficial till the tops acquire a good size; but when there appears a disposition to form thick necks, a slight check from drought will assist in the formation of bulb. When the onions approach maturity, water should be withheld; for if much water be absorbed at that time it cannot be thrown off effectually by the decaying foliage, and the bulbs consequently cannot be expected to keep so sound as when their tissues are filled with the properly elaborated and more inspissated juices of the stem. When the foliage begins to flag, and the stems to bend, it is a sign that they have performed their part as regards the growth of the plant, and the first opportunity of dry

weather should be seized to pull up the bulbs; after heavy rain it would not be desirable to do so till several dry days have elapsed. But whatever may be the state of the weather, care should be taken to pull up the onions before a second growth commences, for if it do, they will not keep well, and if wet weather should prevail, the best plan is to take the crop up, and lay it on a dry surface, sheltered from rain, but exposed to air, and to whatever sunshine there may be. Onions when pulled are usually laid on the ground with their roots towards the south, in order that the sun's rays may assist in withering them. They should be turned over on a dry day, and when the surface of the ground is dry. In private gardens it is sometimes possible to lay the onions on a dry gravel walk, or some other hard surface, and this is preferable to the cultivated ground, because more free from exhalations. When the roots and tops are completely withered, the greater portion of the latter should be taken off, and the bulbs may then be stored in a dry cool place. They keep very well in a loft above an open shed, secured, however, from frost by a covering of straw, and a lining of the same material round the walls. They also keep well strung together by the remaining portion of the top, a string being tied firmly round the necks of a few, then successively adding others, and winding round the string; or, for greater security, the onions are tied on a straw rope. In either case they can be suspended so as not to touch the walls of the place in which they are stored. Onions have been known to keep well till late in the spring by storing them several feet thick in a cool loft, without turning, or in any way disturbing them, till finally removed for use.

Sowing for Pickling Onions.—The White Spanish or Reading, the Early Silver-skinned, and the Nocera, are sorts adapted for this purpose. As security against failure, some of each of these may be sown. The ground should be rather poor than rich, and it should not be manured. It must be firmly trodden, and then smoothed with the back of the rake. The seed should be sown thickly in March, covered very slightly, and the ground should be well rolled. If the seed is covered deeply the bulbs are apt to become oblong instead of round, or oblate. Thinning is not required, for the plants should be very thick, and it is the duty of the sower to scatter the

seed so that the plants may not be in too dense patches.

If the onion be sown early in spring, and cultivated so as to attain a fair size; and if the bulb be taken up when mature, and replanted in the following spring, it pushes fresh roots, sends up a flower-stalk, produces seeds, and dies; but if sown in autumn, the plant will survive ordinary winters, and produce a large bulb in the course of the following spring and summer. It will, however, become much larger, if, instead of being allowed to remain in the seed-bed, it be transplanted early in spring, or as soon as the weather will permit. If an early sort be sown thickly in not very rich soil, in the beginning of May, small bulbs will be matured sufficiently well to keep through the winter; and, in consequence of having been sown late, and from being of small size, they will not be disposed to run to seed when replanted in spring, and their vegetation not taking that direction, the small bulbs become very large. It thus appears that very large onions result from two seasons' growth, as is the case when the small bulbs of one year's growth are planted in the spring of the next, or when a growth made in autumn is continued in the following spring and summer. It is by a mode analogous to this that the large Portugal onions are produced. In Portugal they do not require to be sown so early in the autumn as in Britain; but they are forwarded in a little heat in November and December, and thus have a considerable amount of substance elaborated before the spring-sown onions are above ground. From having this advantage, they swell to a much larger size than those which are sown in March, and which have, consequently, a much shorter period of growth; for, whether sown in autumn, or early or late in spring, the onion has a disposition to rest after the hottest period of the summer is over.

From what has been stated it appears:—

1. That onions may be sown in autumn, and either drawn young in spring, or allowed to attain maturity in the bed without transplanting.
2. That they may be sown in autumn and transplanted in spring.
3. That an early sort may be sown in May, under circumstances conducive to the formation of only very small bulbs, which being planted in spring form much larger bulbs than are obtained in the same kind of soil from seeds sown at that season.

Autumn Sowing for Drawing as required without Transplanting.—For this purpose seed of the White Spanish, or of the Silver-skinned, should be sown about the 17th of August. The ground must be well prepared, rolled with a light roller, and sown; it should then be worked off in 4-foot beds with 1-foot alleys, and from the latter soil should be taken to cover the seeds about $\frac{3}{4}$ ths of an inch deep. The seed-bed must then be lightly and evenly raked, and again rolled. The seeds of autumn-sown onions require to be covered to a greater depth than those sown in spring, otherwise they are liable to be thrown out of the ground by frost; on this account, in sandy soils, an inch deep will not be too much.

Autumn Sowing for Transplanting in Spring.—For this purpose the White Spanish or Reading is sown in the first week of September, and transplanted as early in spring as the state of the weather will permit, in ground prepared as for the spring-sown crops. The plants may be 6 inches apart, in rows 1 foot asunder. The distance should, however, be varied according to the richness of the soil; for if the ground is highly manured, and if other means are adopted to produce very large onions, the plants may be 1 foot apart, in rows 15 inches asunder. The plants should be carefully removed from the seed-bed, in order that their roots may be preserved as entire as possible. It is scarcely necessary to observe that the plants, whilst out of the ground, should not be exposed to the trying influences of the air. Previous to taking up, the bed ought to be well watered, and when the water has subsided, so that the soil is just free from being saturated, it should be loosened with a fork. On a large scale, the dibber is almost necessarily employed; and in this case the ground should be lightly rolled previous to planting; but in private gardens the following method will be found preferable:—The ground having been prepared, let a line be stretched, and the surface made smooth and close by beating with the spade, lightly, if the ground is rather moist and strong; more heavily, if light and sandy. Next cut by the line a small trench; and if some good compost can be spread in the bottom, so much the better. Then, with the plant in one hand, place the roots so that the fibres only shall be under the surface. The fibres should then be spread out and covered by soil brought forward by the hand not occupied in holding the plant, at the proper depth. When

the row is thus planted, and the soil levelled in, the latter should be made even, and rendered moderately compact with the back of the spade. Proceed in this manner till the whole is finished, watering as the transplanting goes on, and subsequently when the plants absolutely require it. If onions for drawing young are likely to be in demand, the plants may be put at half the distance in the rows at which the crop is to remain, and every other one taken out for early use.

The very large onions from Portugal are produced, as previously stated, by transplanting; and the following account of the system pursued in that country is given by Mr. Warre, in the *Transactions of the Horticultural Society*:—

“The general practice of cultivating the onion in Portugal, is to sow the seed very thinly in November or December, on a moderate hot-bed in a warm situation, with a few inches of light rich loam upon it, and to protect the plants from frost by mats and hoops. In April or May, when they are about the size of a large swan’s quill, they are transplanted on a rich light loam well manured with old rotten dung. The mode of transplanting is particular. The plants are laid flat, about 9 inches asunder each way in quincunx, the head of the root, and part only of the plant, lightly covered with very rich mould, well mixed with two-thirds of good old rotten dung. This compost is slightly pressed down on the plant; water is given when the weather is dry till the plants have taken root. Subsequently the earth is occasionally broken around them by slight hoeing. In Portugal, the means of irrigation are easy, the effects of which are particularly beneficial to the onion, for by letting the water filter or pass through small heaps of dung placed in the alleys of the beds, a very rich liquid flows in upon the plants. The dung as it is exhausted or washed away should be renewed, and the water must be checked in its current, so that it may gently spread over the surface.”

Transplanted onions frequently escape the grub in gardens where the spring-sown crop is greatly injured by it. Mr. McKenzie, gardener at Rosenhaugh, near Inverness, gives an account in the *Gardeners’ Chronicle* of the mode by which he obtained a superior crop of sound onions from autumn sowing. In autumn he made choice of a rich sandy loam, well exposed, and sheltered only by a hedge. The

ground was well manured with vegetable mould and pigs’ dung. After digging, he opened drills $1\frac{1}{2}$ inch deep, and 12 inches apart; a little pigeons’ dung, which had been three months exposed to the weather, was spread in the drills. On the 8th of September, the Strassburg onion was sown, and the seeds covered with the feet, the surface being afterwards raked smooth. On the 6th of May, the plants in the drills were thinned to 3 or 4 inches apart. The thinnings, removed with all their roots, were transplanted into a piece of ground prepared and manured as above, with the exception of pigeons’ dung. In transplanting, the fibrous roots only were covered; the ground was gently pressed and watered as the planting went on, and in dry weather every evening for eight days. None of the plants were attacked by the maggot, whereas the spring-sown onions were nearly all destroyed by it in the same kind of ground, and to which the same kind of manure had been applied.

Planting Small Bulbs of the Preceding Year’s Growth.—To produce these, sow the Two-bladed, if it can be obtained, or otherwise the White Spanish or Reading, about the 10th of May, in dry, rather poor soil, in the manner directed for sowing pickling onions. If the weather be dry, give a good watering immediately after sowing, but no more. Let the bulbs be taken up when ripe, and when perfectly dry they may be kept in paper bags, in a cool place, till the beginning of February, when, if the weather permit, they should be planted in rich soil, 4 inches apart, in rows 9 inches asunder; and 6 or 8 inches apart, in rows 1 foot from each other, if very large bulbs are desired. The ground having been prepared, trodden, and then raked, the bulbs should be taken between the finger and thumb, and pressed a little way into the ground. If there should be any small onions, not larger than a hazel nut, they may be planted in the same way.

Production of Offset Onions.—By sowing thickly in April, and allowing the plants to remain without thinning, bulbs of small size will be produced. Those of the size of walnuts should be planted in January or February, pressing the bulb into the ground so as scarcely to cover the top. When the stem begins to shoot up for seed, it should be broken off, and in consequence of the check to the growth in this direction, young bulbs form round the old ones. It is stated by Mr.

Smith, in a communication to the Horticultural Society, that by a similar process young onions, 2 or 3 inches in circumference, and fit for the kitchen, may be obtained at a time when spring-sown onions are not larger than quills, and that onions thus thrown into clusters, will be full grown and fit to take up by the end of June. They do not keep; but this, we may add, is of no great consequence, as their principal use is to afford a supply between the new and old crops.

Cultivation of the Potato or Under-ground Onion.—This is generally planted as early in the spring as the weather will permit, but it may be planted in December, especially if the bulbs then begin to push. The ground should be deep, rich, and well prepared; the bulbs should be planted almost on the surface, and in rows 15 inches apart, and about 10 inches from each other in the row. In Devonshire, where this sort of onion is much cultivated, the rule is to plant on the shortest day, and to take up the crop on the longest. They plant in rows 1 foot apart, and place the bulbs at 6 inches from each other in rows. The winters in Devonshire are mild, but in parts of the country where this is not the case, early spring planting is to be preferred.

Maher (*Horticultural Transactions*, vol. iii. p. 305) covers the bulbs with leaf-mould, rotten dung, or any other light compost, so that just the crowns are exposed. As they push, the plants are earthed up like potatoes, and in this way they form large clusters. Mr. Wedgewood, on the contrary (*Horticultural Transactions*, vol. iii. p. 403), removes the soil from the bulb. When the onions have shot out their leaves to their full size, and when they begin to get a little brown at the top, his plan is to clear away all the soil from the bulb down to the ring from which the fibres of the roots proceed, and thus form a basin round each bulb, which catches the rain and serves as a receptacle for the water from the watering-pot. The old bulbs then immediately begin to form new ones, and if the roots are kept moist, and if the soil is good, the clusters will be very large and numerous. The bulbs thus grown above ground are much sounder than those formed beneath the surface, and will keep much better.

Cultivation of the Tree Onion.—This may be propagated by the bulbs formed in the ground; also by the small bulbs formed on the stem. The former are planted 1 foot apart

each way, in shallow drills, about the same time as the main crop of onions is sown in spring, and the stem-bulbs in the beginning of April, 4 inches apart, in rows 8 inches asunder. Stems that bear heavily require to be supported. When mature, the stem bulbs should be gathered, dried, and kept free from damp, in a cool place.

It is attempted to grow onions in almost every cottage garden, in some, or indeed in many of which, the soil is not well adapted for this crop; yet it is important to the cottager that he should be able to raise a supply. We may therefore give some of the modes of cultivation, by which difficulties in the way of raising good crops on indifferent or even bad soils have been overcome, and from which some useful hints may be obtained. The following method, of which the peculiar advantage is, that good onions may be obtained by it on a very moderate soil, without the abundant supply of manure which broadcast sowing requires, was communicated to the Horticultural Society by Mr. James:—

The seed is sown on a slight hot-bed in the second week in March; the plants, when up, are exposed to the air whenever the weather permits, and in the last week in April, they are planted out in the following manner:—Deep drills are made on a piece of well-dug ground, 15 inches asunder, and the drills are filled with a good compost of equal parts of sandy loam and rotten dung; the plants being drawn carefully from the beds, are placed in these drills at 12 inches' distance from each other, their fibres only being covered with the mould, and the entire bulb kept above ground. When planted, they receive a gentle watering, which is continued daily, unless rain falls, till the roots have got hold of the compost. They are afterwards hoed when necessary, and occasionally watered, till they are fit to take up. Mr. James has found that by sowing onion seed on a good south border in the second week in September, the plants, if of a hardy variety, will stand the winter, and that they may be treated in the spring as above described, with the same success as if they had been raised on a hot-bed.—(*Horticultural Transactions*, vol. iv. p. 130.)

Mr. Snow describes (*Gardeners' Chronicle*, 1844, p. 606) a mode of culture by which he obtained a fine crop on the worst ground for the cultivation of onions that he ever met with. The ground was deeply dug late in

autumn, left in a rough state, and salted with common salt. He then spread, separately, on different portions, hog, cow, and horse manure. The manure thus spread over the surface was allowed to remain till April, when it was forked off and wheeled away. Onions drawn from the seed-bed were planted in this piece of ground, and the result was as fine a crop as could be desired. It was good on all the portions, but best on that to which the hog-manure was applied. The onions were perfectly free from the grub, whereas in other parts of the garden, three-fourths of the crop was attacked by it.

In the soil of the garden at Rosenhaugh, a light sandy loam which had been under garden crops for sixty years, onions did not succeed well. Mr. Mackenzie, however, found a very successful remedy in the following application:—He laid some rich clay where all the house slops were thrown upon it from July till the following February. The ground intended for onions having been dug in autumn, the clay was spread upon it 3 inches thick, and left in that state from February till March, when it was stirred up, pulverized, and mixed with some of the earth, at the same time. A good barrow-load of pigeons' dung, fresh from the pigeon-house, was then spread on every 20 square yards of surface. On this the seed was sown, pressed hard with the back of the spade, and covered with about $\frac{1}{4}$ inch of well-broken earth from the alleys. The result was an excellent crop, as regards both size and quality, and in every respect much superior to that obtained from ground treated in the ordinary way.

To save Seed.—For this purpose select some of the largest and best formed onions when the crop is taken up. Plant them either in November or February, in warm soil, and in a situation well exposed to the sun, but sheltered from wind. In planting, drills should be formed 3 or 4 inches deep, according to the size of the bulbs. These should be planted in perfectly straight rows, 1 foot apart, and 6 inches asunder in the row. Instead of drills, the bulbs may be planted in holes made by the dibber. The flower-stems require support as they advance in height. Stakes should therefore be driven in, and tarred cords stretched horizontally on each side of the row of stems. In August or September, when the seed is ripe, the stalks should be cut over by the ground, and laid on a cloth in the open air for a few

days to dry; but during this process the seeds ought not to be exposed to rain. The seed keeps good for two years, seldom longer.

Insects.—The onion crop is sometimes destroyed and frequently much injured by the maggots of the onion-fly (*Anthomyia ceparum*). These, on emerging from the eggs, bore through the outer leaf, and descend between the leaves into the bulb, which they feed upon, and soon destroy. As soon as the presence of this insect is detected, all the plants attacked, which are easily known by the leaves fading and turning yellow, should be at once pulled up, burned, and lime-water poured into the holes. Strewing soot or powdered charcoal round the plants, leaving a few unprotected as traps, has been found useful. Saturating the beds with strong soapsuds has likewise been attended with some success. Soot, applied to the ground previous to sowing, is found to be an excellent preventive of the attacks of this insect; and so are deep trenching and the alternation of crops. The maggots of the brassy onion-fly (*Eumerus aeneus*) likewise attack the bulbs, in the destruction of which the snake millepedes (*Juli*) and *Polydesmus complanatus* also assist.

ORACH, or Mountain Spinach (*Atriplex hortensis*, L.—*Polygamia Monœcia*, L.; *Chenopodæ*, D. C.; *Chenopodiaceæ*, Lind.) is a hardy annual, a native of Tartary. The leaves are used as a substitute for spinach, and to correct the acidity of sorrel.

Four varieties are distinguished:—

1. WHITE ORACH, OR PALE-GREEN LEAVED.
2. GREEN ORACH.
3. RED ORACH.
4. DARK RED ORACH.

This plant will grow well in any soil; but the leaves are largest and most succulent in rich soils. It should be sown in drills 2 feet apart, thinning out the plants when 3 or 4 inches high, to 20 inches apart in the row. Or seed may be sown broadcast in a small bed, and the young plants transplanted to the above distances. It may be sown any time from the end of February to September; a sowing in March, and one in June, for succession, will, in general, prove sufficient; but if in constant demand, it must be sown more frequently, for it soon runs to seed. Where seed is not to be saved, the flowers should be pinched off, as the seed is very light and easily carried by the wind; it should be gathered before it is completely ripe, and dried and shaken out upon a cloth.

OXALIS CRENATA (Jacq.—Decandria Pentagynia, L.; Oxalideæ, D. C.; Oxalidaceæ, Lind.) is a tuberous rooted plant, a native of Peru, whence it was introduced into this country in 1829.

Several varieties of this plant are cultivated in Peru, under the name of Oca. Two sorts have been brought to Europe. In one of these the tubers are covered with a yellow skin; in the other, with a red one; their comparative merits have not as yet been ascertained. The tubers, which are produced in great abundance, seldom exceed the size of a hen's egg. They are covered with a smooth skin, and have numerous eyes, by which the plant may be propagated. Their composition, according to Payen, is as follows:—

Starch,	2.5
Albumen,	1.5
Gum, &c.,	5.5
Woody fibre,	4.4
Water,	86.1
	<hr/>
	100.0

They, however, possess a somewhat acid taste, which is rather disagreeable; but it may be removed by changing the water when they are about three-quarters boiled; or by the process given in the following interesting observations of M. Decaisne respecting this plant:—

“The Oca is very extensively cultivated in the temperate parts of Bolivia, where several varieties are distinguished. Two are known by the names of *Oca blanca* and *Oca colorada*. The museum is indebted to M. Bourcier, French consul at Quito, for the latter, which he considers superior in quality to the *Oca blanca*, although Mr. Weddell is of a different opinion. The *Oca blanca* is beginning to appear in our markets; it is now to be found in most greengrocers' shops, but the slightly acid flavour of the tubers is disagreeable to some persons. This acidity may be converted into a sugary flavour by exposing them to the sun, which converts the acid into saccharine matter. This phenomenon is analogous to what goes on at the ripening of most fruits. The Oca, when treated in this way, loses all trace of acidity, and becomes as floury as the best varieties of potatoes. According to Mr. Weddell, the Oca should be exposed to the sun from six to ten days. In Bolivia this operation is performed in woollen bags, which appear to facilitate the conversion of the acid. To obtain this result, the

bags should contain no more tubers than are sufficient to form a thin layer within the bag. If the action of the sun is continued for several months, the Ocas become of the consistence and sweet taste of dried figs; they are then called *Cauí*. The Cauí is cooked by steam, the tubers being placed on a bed of straw, which keeps them from contact with the water over which they are cooked. In Bolivia, and more especially at La Paz, the Oca is cultivated to double the extent of the potato. The price is also twice as high as that of the last-named vegetable.”—(*Horticultural Society's Journal*, vol. ix. p. 58.)

At Lima, the leaves and young tops are eaten in salad, and they may be substituted for sorrel, which they resemble in flavour, both plants, in fact, containing a considerable amount of oxalic acid. The stems have also been proposed as a substitute for rhubarb and gooseberries in tarts, but never having tasted them when so treated, we must be silent on their merits.

The *Oxalis crenata* requires a light rich soil and a warm situation. It is propagated by sets like the potato, or by cuttings, which easily take root. The sets should be planted on a hot-bed in March, and planted out in May, 2½ feet apart, in rows a yard asunder.

According to Mr. Maund, the mode of culture which is likely to cause the greatest production of tubers consists in laying the stems, and covering them with light rich mould as they proceed in growth, leaving only perhaps 6 inches of the end of each shoot out of the soil. A similar course is recommended by M. Guesnet, who states that the earthing up should be commenced when the shoots are about 4 inches in length, and continued till September, when the tubers begin to form. These may be allowed to remain in the ground till late in autumn, or till the stems are cut down by frost, when they should be taken up and preserved in sand, in a dry place throughout the winter.

This plant being easily killed by frost, it is only in warm seasons that tubers are formed in England, although abundance of foliage is produced. There is, however, no room to doubt that the plant would succeed perfectly well in the warmer parts of the United States.

OXALIS DEPPEI (Bot. Cab.—Decandria Pentagynia, L.; Oxalideæ, D. C.; Oxalidaceæ, Lind.)—This is a perennial plant, a native of Mexico, whence it was introduced into this

country in 1827. According to Professor Morren, the following are the uses to which this oxalis has been applied in Belgium:—

“The uses of the oxalis are many. The young leaves are dressed like sorrel in soup, or as a vegetable; they have a fresh and agreeable acid, especially in spring. The flowers are excellent in salad, alone, or mixed with corn salad, endive of both kinds, red cabbage, beet-root, and even with the petals of the dahlia, which are delicious when thus employed. When served at table, the flowers with their pink corolla, green calyx, yellow stripes, and little stamens, produce a very pretty effect. The roots are gently boiled with salt and water, after having been washed and slightly peeled; they are then eaten like asparagus in the Flemish fashion, with melted butter and the yolks of eggs. They are also served up like scorzonera and endive, with white sauce. They form, in whatever way they are dressed, a tender, succulent dish, easy to digest, agreeing with the most delicate stomach. The analogy of the root with salep, indicates that its effect should be excellent upon all constitutions.”—(*Gardeners' Chronicle*, 1841, p. 68.)

The roots are fleshy, tapering, white, and semi-transparent, and furnished on the top of the crown with a mass of scaly bulbs, sometimes amounting to fifty in number, by means of which the plant can easily be propagated. When well grown, the roots are about 4 inches in length, and from 1 inch to $1\frac{1}{2}$ inch in thickness.

The *Oxalis Deppei* requires a light rich soil, mixed with decayed vegetable matter, and it prefers a southern aspect, provided the soil is not dry. Professor Morren states that it does not thrive in loam, still less in calcareous earth, and that it always suffers in heavy land, where it often will not produce its tap-roots.

It may be raised from seed, but is generally propagated by planting the bulbs, about the middle or end of April, or when all danger of frost is over, 6 inches apart, in rows 1 foot asunder. The bulbs should be only just covered with soil, for thus they occupy a position with regard to the surface similar to that in which they are produced; and this seems indispensable, if fine roots are to be obtained. The stems have been observed to spring up from a considerable depth; but in this case tap-roots were not formed.

The following is the subsequent treatment

which we recommended in a paper on this plant in the *Transactions of the Horticultural Society of London* (second series, vol. iii. p. 32):—“During summer, the soil must be kept moist in dry weather; otherwise, when rain falls abundantly, the sudden accession of water to the roots occasions their splitting. The plants should be allowed to grow as long as there is no danger from frost; but previously to this occurring, they should either be taken up or protected. If protected from frost, by frames or otherwise, the roots will continue to increase in size till November. When taken up, the roots should be divested of the numerous bulbs formed on their crowns, and then stored up for use in a cool dry place, but secure from frost. A similar situation will be proper for the bulbs, or they may be kept in dry sand till the season of planting.

“Mr. Cockburn, gardener to the Earl of Mansfield, at Caen Wood, Hampstead, grows this plant in perfection, with no particular preparation of soil; merely planting the bulbs in shallow drills, 1 foot apart, in borders dug and manured as for other kitchen garden crops.”

The bright rose-coloured flowers being very ornamental, the plant is sometimes employed as an edging for walks, particularly on the Continent.

PARSLEY (*Petroselinum sativum*, Hoffm.; Pentandria Digynia, L.; Umbelliferae, D. C.;

Fig. 159.



Apiaceae, Lind.) is a hardy biennial, a native of Sardinia. It is extensively used in stuffings, for flavouring soups and stews, and as a gar-

nish. The Fool's Parsley, *Ethusa Cynapium*, a poisonous plant, belonging to the same natural order as the true parsley, bears considerable resemblance to the plain-leaved variety of the latter, and dangerous mistakes sometimes occur in consequence. When eaten it produces nausea, numbness, and insensibility; and, in some cases, even death. According to Dr. Christison, the best applications in case of accident are milk, mustard poultices on the legs, and cold sponging with vinegar. It may, however, be readily distinguished from parsley by the unpleasant smell of the leaves when bruised, by their being of a much darker green, and of a different shape. It is further and more certainly known, by having three long narrow leaves hanging down from one side of each of the partial umbels, as in Fig. 159. Mistakes may, however, be altogether avoided by cultivating only the curled sorts.

The varieties of parsley are:—

1. COMMON PARSLEY.—The leaves of this are plain, and the plant produces them in greater quantity than the curled sorts, than which it is also somewhat hardier; nevertheless it is so much inferior to them in quality and appearance that its cultivation ought to be discontinued.

2. DWARF CURLED PARSLEY—syn. Englefield Curled Parsley, Sutton's Dwarf Curled, Usher's Curled, Persil nain très frisé.—This is a very fine dwarf curled variety, which has been for many years imported into this country, and distributed by the Horticultural Society of London, and most probably, under high cultivation, it has given rise to other varieties, which, whilst retaining its fine curl, are of stronger growth. It is slow in running to seed.

3. RENDLE'S TREBLE GARNISHING.—This is described in the *Journal of the Horticultural Society* as having proved of stronger growth than the preceding, and being beautifully curled. It is an excellent variety, and one highly deserving of cultivation.

4. MYATT'S TREBLE CURLED—syn. Myatt's Treble Garnishing, Myatt's Extra Fine Curled.—This grows about as tall as Rendle's Treble Garnishing, and, if obtained true, is as finely curled.

5. MITCHELL'S WINTER MATCHLESS.—This is finely curled, and is considered hardier than some of the other curled sorts.

6. HAMBURG PARSLEY.—Only cultivated for its fleshy roots, which are eaten like parsnips.

7. NEAPOLITAN, OR CELERY - LEAVED.—Persil-céleri of the French.—This is grown for the leaf-stalks, which are blanched and eaten like those of celery.

Parsley requires a good, but not too rich soil, and a somewhat shady situation. It is raised from seed, which may be sown any time between February and the end of August. A sowing in January or February, another in April or May, and one in July for winter and spring use, will in general suffice. The last sowing should be made at the foot of a south wall, and the plants ought to be covered with hand-glasses in frosty weather. The seed should be sown in drills 1 foot apart, and covered with fine mould to the depth of about $\frac{1}{2}$ an inch. It usually takes several weeks to come up. In dry weather the seed-bed should be frequently watered; and, when the young plants are sufficiently strong they may be thinned out, first to 3 inches apart in the row, and afterwards, when rather further advanced, to 6 inches from each other. Parsley is frequently sown as an edging, but in this way, wherever there is much traffic, the leaves are liable to get bruised and dirty. In gathering for use, the largest and best leaves are picked off singly. When the leaves become old, and no longer tender, the plants should be cut over, and fresh ones will be produced. This may also be done in autumn, when no sowing has been made for winter supply. In frosty weather some plants should be protected with fern or litter.

In saving seed of the curled sorts, the plants with the most perfectly curled leaves should be selected and transplanted into an open spot of ground by themselves. The seed ripens in July, and preserves its vegetative powers for two or three years.

Culture of Hamburg Parsley.—In order to have large roots of this, the ground should not be too highly manured, but it ought to be deeply trenched. The seed is sown early in March, in shallow drills 1 foot apart, and the plants are thinned out to 10 inches asunder in the rows. In October or November, the roots, having attained their full size, are taken up and preserved in sand, or kept in earth in a border.

Culture of Neapolitan Parsley.—This may be sown in March, and again in May for a succession. The seed should be sown thinly broadcast, and raked in. When the young plants are about 4 inches high, they should be trans-

planted into trenches about 6 inches deep, and 2 feet apart; the distance between the plants in the trench may be 9 inches. Afterwards they must be treated like celery in regard to earthing up, but they require less moisture.

PARSNIP (*Pastinaca sativa*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceae, Lind.)—The parsnip is a hardy biennial, a native of England, cultivated for its roots, which are eaten along with meat and fish, or in soups. A tolerable wine may also be made from them. They are very nutritious, their composition, as determined by Dr. Voeleker, being:—

	Natural State.	Dry.
Water,.....	82.050	...
Vegetable fibre,.....	8.022	44.691
Inorganic matters attached to the fibre, .....	.208	1.159
Insoluble albuminous compounds, .....	.550	3.064
Soluble casein,.....	.665	3.704
Nitrogen in the form of ammoniacal salts, .....	.033	.184
Pectin and gum, .....	.748	4.166
Salts insoluble in alcohol, ....	.455	2.535
Sugar,.....	2.882	16.055
Salts soluble in alcohol, .....	.339	1.888
Starch,	3.507	19.537
Fatty oil,.....	.546	3.041
	100.005	100.025

The following is a general summary of the results of the above analysis:—

	Natural State.	Dry.
Nitrogenized matters capable of forming flesh,	7.30	7.25
Substances, not containing nitrogen, fitted for the support of respiration and formation of fat,	9.65	87.18
Ashes,	1.00	5.57
Water,	82.05	...
	100.00	100.00

The composition of the ash has been ascertained by Dr. Richardson to be in 100 parts—

Potash,	36.12
Soda,	3.11
Magnesia,	9.94
Lime,	11.43
Phosphoric acid,	18.66
Sulphuric acid,	6.50
Silicic acid,	4.10
Phosphate of iron,	3.71
Chloride of sodium,	5.54
Charcoal and loss, .....	.89

The varieties of parsnip are:—

1. **COMMON PARSNIP**—syn. Swelling Parsnip, Large Swelling Parsnip.—The roots of this are from 3 to 4 inches in diameter at the shoulder, thence tapering regularly to the depth of 20 or 30 inches. Crown generally below the surface of the ground.

2. **GUERNSEY PARSNIP**—syn. Jersey Parsnip, Panais long of the French, Panais coquin of Guernsey.—An improvement on the preceding; the roots, which are long and tapering, sometimes attaining the length of 3 feet in this country, and 4 feet in Guernsey, are nearly the same in quality as those of the common parsnip.

3. **HOLLOW-CROWNED PARSNIP**—syn. Hollow-headed Parsnip, Panais Lisbonnais of Guernsey.—The leaves of this are shorter than those of the common parsnip; the roots are about 18 inches long, 4 or 5 inches in diameter at the thickest part, and end somewhat abruptly in a small tap-root. The crown is hollow round the insertion of the foot-stalks, and is generally below the surface of the ground. When well-grown they sometimes weigh as much as 5 lbs., and in quality they are excellent, being tender and of fine flavour. It is the best variety for general cultivation.

4. **TURNIP-ROOTED PARSNIP**—syn. Round Parsnip, Panais rond, Panais royal, Panais de Metz.—Leaves not numerous; roots resembling a round turnip in shape, from 4 to 6 inches in diameter, and terminating in a strong tap-root. It is the earliest sort, and from the root growing principally above ground, it succeeds well in ground too shallow for the other kinds.

Besides the above there is another variety, the Panais bâtard, or Panais de Siam, which is said to be more tender and richer in flavour than the other sorts. It is mentioned by Dr. Neill, in the *Encyclopedia Britannica*, and is described by M. Noisette, in his *Manuel complet du Jardinier*, as being yellowish in colour, and in form intermediate between the Guernsey and Turnip-rooted parsnips; he also states that it is the most esteemed. It does not, however, appear to be known at the present day in this country.

The parsnip succeeds best in a rich deep soil, not too stiff, and an open situation; a free sandy loam is well adapted for its growth. The ground where it is intended to be grown should be trenched and manured if necessary in the autumn, as the addition of fresh ma-

nure just before sowing causes the roots to fork. The seed should be sown thinly, in the middle of March, in shallow drills 18 inches apart. When the plants are about 2 inches high they may be thinned out where too close, but not finally, till they are further advanced, when they may be thinned out to 1 foot apart, or to 15 inches if very large roots are desired. With the exception of hoeing the ground, nothing further will be required till the leaves begin to decay in the end of October or beginning of November, when a portion of the roots may be taken up and stored in dry sand, for use in frosty weather; but as they are always best when newly dug up, the principal portion should be allowed to remain in the ground to be taken up for use as required. The remainder may be taken up in February, before they begin to shoot, and stored for use. These will keep till April or May in a dry cool place.

If seed is to be saved, some of the best roots should be carefully taken up and replanted 2 feet apart in a sheltered situation, where they will flower in July, and ripen seed in the end of August. Seed more than one year old seldom germinates.

Insects.—Several insects attack the parsnip; the celery-fly (*Tephritis onopordinis*) lays its eggs in the leaves, and the larvæ which result live upon the parenchyma, producing large blisters. The best mode of preventing further inroads is to pinch the blisters and burn all leaves that are much infested. The maggots of the carrot-fly (*Psila Rosæ*) as well as those of *Psila nigricornis*, eat passages in the roots; and the caterpillars of *Depressaria applanata*, *D. Daucella*, and *D. depressella*, feed upon the flowers and seeds.

PATIENCE, Patience Dock, or Herb Patience (*Rumex Patientia*, L.—Hexandria Trigynia, L.; Polygoneæ, D. C.; Polygonaceæ, Lind.) is a hardy perennial, a native of Italy. The leaves were formerly much used in this country as spinach, and are still in some parts of France; where they are also employed in the early part of the season as a substitute for sorrel, being produced several days sooner than the leaves of that plant. The leaves should be gathered when tender, and if used instead of spinach, should be mixed with a fourth part of sorrel.

The plant will grow well in almost any soil, but best in one that is rich and rather moist. It may easily be raised from seed sown in spring in drills 18 inches asunder, afterwards thinning out the young plants to

1 foot apart in the rows. It may also be sown broadcast in a seed-bed, and planted out. Or the roots may be divided, and planted at the above distances. The stems naturally grow to the height of from 4 to 6 feet, but should be cut over several times in the course of the summer, to induce them to throw out young leaves in succession, and to prevent seed from being ripened and scattered about in all directions, for when this takes place, the plant becomes a troublesome weed.

PEA (*Pisum sativum*, L.—Diadelphica Decandria, L.; Leguminosæ, D. C.; Fabaceæ, Lind.)—The pea is a hardy annual, most probably a native of the Levant, where the common gray field-pea, supposed to be the parent of the garden varieties, is found wild. The uses of the seeds are so well known as not to require mention here. As an article of food, pease, whether in a green or in a ripe state, are very nutritious. According to Dr. Voelcker, the average proximate composition of ripe pease, as calculated from the analyses of Horsford, Krockner, Einhof, Braconnot, and Boussingault, is as follows:—

	Air-dry.	When quite dry.
Legumin,	23·4	27·24
Starch,	37·0	43·07
Fatty matters,	2·0	2·33
Grape sugar,	2·0	2·33
Vegetable fibre,	10·0	11·64
Pectic acid,	4·0	4·65
Gum,	5·0	5·82
Inorganic matters (ash),...	2·5	2·92
Water,	14·1	...
	100·0	100·00

Pease, according to this average analysis, thus contain:—

	Air-dry.	Quite dry.
Nitrogenized or flesh-forming constituents,	23·4	27·24
Substances free from nitrogen, fitted to support respiration and to lay on fat:—		
<i>a</i> , Starch, sugar, fat, &c.,	50·0	58·20
<i>b</i> , Vegetable fibre,	10·0	11·64
Ash used to supply the materials for the formation of bones, &c.,	2·5	2·92
Water,		
	14·0	...
	100·0	100·00

The average composition of the ashes of pease, as derived from several analyses, may be stated as follows:—

Potash,	36.67
Soda,	7.32
Lime,	5.39
Magnesia,	8.62
Oxide of iron,	1.00
Phosphoric acid,	33.88
Sulphuric acid,	4.43
Chloride of sodium,	2.17
Silicic acid,	0.52

100.00

It is a generally admitted fact, that the varieties of pease are far too numerous, and yet reputed new ones are eagerly sought for. Whilst this is the case, new names will doubtless annually appear in seedsmen's lists, and the varieties to which such names are applied may not be permanently distinct from some already known. An Early Frame, for instance, may be saved under particular circumstances of soil and situation; and it may, in consequence, be somewhat altered in character. In a few years, however, its generations may return to their original type; but until this is the case, some distinguishing designation may be allowed to the sort. We shall endeavour to classify the varieties at present known; and by means of this classification, together with the descriptions, it is presumed that the principal sorts will be readily distinguished; and if that be the case, new sorts may be easily arranged by the side of such old ones as they most resemble, so that if both be grown in adjoining rows, their relative merits can be fairly tested.

Pease may be arranged into the following classes:—

I.—PEASE, WHITE.

- § 1. Dwarf sorts.
- § 2. Tall sorts, requiring sticks.

II.—PEASE, BLUE, GREEN, OR LIGHT OLIVE.

- § 3. Dwarf sorts.
- § 4. Tall sorts.

III.—PEASE, WRINKLED OR INDENTED WHEN DRY.

- § 5. Dwarf sorts.
- § 6. Tall sorts.

IV.—PEASE WITHOUT A TOUGH LINING TO THE PODS.

- § 7. Dwarf sorts.
- § 8. Tall sorts.

I.—PEASE, WHITE.

§ 1.—*Dwarf Sorts.*

1. IMPROVED EARLY DWARF—syn. Nain hâtif extra.—About 1 foot high, very early, and exceedingly prolific in pods, which are straight, nearly round, and contain about six

tolerably large peas. It is well adapted for sowing in frames, and in the open ground it may be sown in rows 18 inches apart; or, with advantage, between the rows of tall pease; for it would be better to do so than to make the rows of the latter too close, as is often the case where ground is scarce. It is a great improvement on the Early Dwarf, or Bishop's Early Dwarf.

2. BISHOP'S NEW LONG-POD.—About 2 feet high; early, bearing abundantly and in succession. Pods nearly straight, almost cylindrical, containing six or seven rather large pease of excellent quality. It was raised by Mr. David Bishop of New Scone, near Perth, and is a cross between Bishop's Dwarf and a Marrow pea. It is not quite so early as Bishop's Dwarf, but in other respects it is much superior. It is the best early dwarf.

3. WHITE PRUSSIAN—syn. Dwarf White Prussian, Prolific or Poor Man's Profit, Royal Prolific, White Prolific, Royal Dwarf, Royal Dwarf Marrow, New Dwarf Norman, Dwarf Twesley, Twesley Marrow, Wrench's White Union, Stowe Pea.—About 4 feet high, a good bearer. Pods long, rather flat, containing seven or eight good-sized peas, which are white when dry. Is fit for use about the same time as the Blue Prussian, but will not continue so long in bearing. It much resembles that sort, except in the colour of the seeds. An excellent summer pea, both as regards quality and productiveness.

§ 2.—*Tall Sorts, requiring Sticks.*

4. EARLY FRAME—syn. Earliest Frame, Early Dwarf Frame, Early Double Blossomed Frame, Single Blossomed Frame, Mason's Double Blossomed, Perkin's Early Frame, Best Early, Superfine Early, Young's Very Early, Early May, Early Wilson, Early Nicholas, Early Nana, Early French, Early One-eyed, Early Warwick, Early Racehorse, Early Hotspur, Golden Hotspur, Dwarf Albany, Batt's Early Dwarf Nimble, Essex Champion, Pois le plus hâtif, Michaux de Hollande, Pois Baron, Pois Laurent, Pois de Paris.—Stems about 4 feet high, and rather slender. Pods small, round, generally containing five or six peas, of excellent quality, and which, when dry, are small, very round, and white. This sort is well known, and is the one usually sown before winter for the earliest production. The flowers sometimes come single, and sometimes

double; the stalk from the same axil branching into two, hence the names of single blossomed and double blossomed have both been occasionally applied to this variety.

5. **PRINCE ALBERT**—syn. Cornack's Prince Albert, Early Kent.—About $3\frac{1}{2}$ feet high, of rather slender growth, not so tall as the preceding, and fit for use a week or ten days before it. In other respects, the characters of this sort are very similar to those of the Early Frame, of which it is a sub-variety.

6. **WAITE'S DANIEL O'ROURKE**—syn. Sangster's No. 1, Sangster's New.—In habit and growth, this resembles Warner's Early Emperor; the pods are larger than those of the Early Frame, and it is as early as the Prince Albert. It is one of the very best sub-varieties of the Early Frame.

7. **EARLY CHARLTON**—syn. Golden Charlton, Hotspur, Early Hotspur, Double Dwarf Hotspur, Wrench's Hotspur, Early Nicholas Hotspur, Nimble Taylor, Paddington, Essex, Reading, Russell's Early Blossomed, White Boiling, Early Sugar Frame, Michaux, Michaux ordinaire, De Ruelle, Dominé, Petit Pois de Paris.—About 5 feet high, and of vigorous growth. Leaves large, with short petioles, tendrils small. Pods broad, containing six or seven peas of excellent quality. They are rather larger than those of the Early Frame, with which this is often confounded. The Early Charlton may, however, be distinguished by its stronger habit of growth, its pods being flat instead of round, its larger seeds, and its becoming fit for use about a fortnight later than the Early Frame; so that when sown at the same time it forms a succession. It is well adapted for standing the winter, and is one of the sorts usually sown for that purpose.

8. **WARNER'S EARLY EMPEROR**—syn. Warner's Early Conqueror, Early Bedalean, Early Railway, Stevenson's Railway, Early Wonder, Beck's Morning Star.—This grows stronger and somewhat taller, and is a few days earlier than the Prince Albert; the pods and pease are also somewhat larger. It is an abundant bearer, and on the whole it must be considered a good sub-variety of the Early Frame.

9. **D'AUVERGNE**—About 5 feet high, and an abundant bearer, ripening about ten days later than the Early Charlton. Pods very long, nearly round, curved at the extremity, and contains frequently ten and sometimes eleven peas, the quality of which is excellent.

10. **DIXON'S EARLY FAVOURITE**—About $4\frac{1}{2}$

feet high, and a most abundant bearer. Pods long, and slightly curved, containing nine or ten medium sized peas, of excellent quality. Those who give the preference to fine and rather small peas, will find this a desirable acquisition. It bears considerable resemblance to the Auvergne; but differs in the pod being less curved. It ripens so as to form a succession to the Early Charlton.

11. **TALL WHITE MARROW**—syn. Tall Marrow, Large Imperial Marrow Fat, Tall Carolina, Large Carolina, New Tall Temple, Clive, Wooton, Princesse, White Rounival, De Marly, Suisse.—From 6 to 7 feet high, of strong growth, and an abundant bearer, but late; pods large, very broad, containing eight or nine large peas of good quality, tender when young, round and white when dry.

II.—PEASE, BLUE, GREEN, OR LIGHT OLIVE.

§ 3.—Dwarf Sorts.

12. **BLUE PRUSSIAN**—syn. Dwarf Blue Prussian, Royal Prussian Blue, Prussian Prolific, Green Prussian, Blue Union, Early Green, Early Dutch Green, Fine Long-podded Dwarf, Nain royal.—Generally from 3 to 4 feet high, very prolific, ripening rather late. Pods mostly in pairs, long, roundish, containing seven or eight peas of middling size, and excellent quality; when dry, of a light blue colour. An old variety, but still highly deserving of cultivation for late summer use. The Blue Prussian, Mr. Masters states (*Gardeners' Chronicle*, 1850, p. 198), is undoubtedly the parent of all the Sabre Blues, Blue Imperials, and the like.

13. **IMPERIAL**—syn. Dwarf Imperial, Blue Imperial, Dwarf Green Imperial, New Dwarf Imperial, New Long-podded Imperial, Sumatra, Dwarf Blue Imperial, Dwarf Blue Prolific, Nain vert impérial, Nain vert gros.—About 4 feet high, pods long, curved at the extremity, which is tapering; they are well filled, containing eight or nine peas of good quality. According to Mr. Masters, this has been derived from the Blue Prussian, and seed from plants grown in poor soil has a tendency to reproduce the original type.

14. **BLUE SCIMITAR**—syn. Sabre, Blue Sabre, Dwarf Sabre, New Sabre.—About three feet high, pods generally in pairs, well filled, long, roundish, gradually curved from the calyx to the point, or scimitar shaped. Seeds of good quality, larger than those of the Blue Prussian, from which the variety has doubtless

originated, and to which, when grown in poor soil, it has a tendency to return. It bears abundantly, but not in succession, and on this account it suits the market gardeners; for all the pods becoming fit for gathering nearly at the same time, an opportunity of at once clearing the ground for some other crop is afforded.

15. **BEDMAN'S IMPERIAL**—syn. Bedman's Dwarf Imperial.—From $2\frac{1}{2}$ to 3 feet high. Pods somewhat curved, roundish, generally containing six or seven large blue peas. An excellent bearer, not early, but highly deserving of cultivation as a summer pea.

16. **GROOM'S SUPERB DWARF BLUE**.—About 18 inches high, and an abundant bearer. Pods large, rather flat, containing about eight peas of excellent quality. A few days later than the Blue Prussian.

17. **DWARF GREEN MARROW**—syn. Early Green, Early Dwarf Green, Royal Dwarf Marrow, Extra Green Marrow, Holloway Marrow Fat, Green Rouncival, Wellington, New Green Nonpareil, Prince's Superfine Sugar, Vert hâtif à la moëlle.—About 4 feet high, prolific, and rather late. Pods large, flattish, straight or slightly bent back. Seeds large, slightly compressed, of excellent quality; light green when dry, and some half-green half-white.

18. **WOODFORD'S GREEN MARROW**.—About 3 feet high. Pods large, flattened, containing about six large peas, which keep long green, and have a fine green colour, and are of good flavour when dressed. An excellent bearer, ripening about ten days later than the Blue Prussian, to which it will form a succession, if both be sown at the same time.

§ 4.—*Tall Sorts.*

19. **BELLAMY'S EARLY GREEN MARROW**.—From $4\frac{1}{2}$ to 5 feet high, and a good bearer. Pods long, straight, cylindrical, generally containing six or seven peas, usually of an olive green when dry, but some are white. Early for a Marrow pea, and on the whole an excellent variety.

20. **ADAMSON'S MATCHLESS MARROW**.—About 5 feet high, an excellent bearer, as early as the Early Charlton. Pods large, flat, curved, containing about seven peas of good quality.

21. **FAIRBEARD'S SURPRISE**—syn. Fairbeard's Early Surprise.—About 5 feet high, and an abundant bearer, becoming fit for use about eight days later than the Early Frame. Pods thick, roundish, slightly curved, containing

from seven to nine large peas of excellent quality.

22. **TALL GREEN MARROW**—syn. Late Green Marrow, Valleyfield, Imperial Green, New Large Green.—Very tall, about 7 feet high. Pods large, broad, rather flat, containing eight or nine peas of excellent quality, and which, when ripe, are of a pale bluish green colour. A good late variety.

23. **VICTORIA MARROW**.—From 6 to 7 feet high; an abundant bearer. Pods remarkably long, being nearly 4 inches in length, generally in pairs, straight, roundish, well filled, containing from six to eight very large peas of good quality, and olive green when dry. This variety bears some resemblance to Knight's Tall Marrow; but like all others it is less sugary than Knight's Marrows. Those who have a fancy for very large pease will find this, perhaps, the largest.

III.—PEASE WRINKLED OR INDENTED WHEN DRY.

§ 5.—*Dwarf Sorts.*

24, 25, 26. **KNIGHT'S DWARF MARROW**—syn. Knight's New Dwarf, Knight's Dwarf Green Wrinkled, Ridé nain.—Of this there are sub-varieties, differing in the colour of the seeds, being either (24) **WHITE**, (25) **BLUE**, or (26) **GREEN**. Stems about $3\frac{1}{2}$ feet high, strong, and branching, with short joints; an abundant bearer, about a week earlier than Knight's Tall Marrow. Pods broad, rather flat, containing about six peas, sugary, and of excellent quality.

27. **HAIRS' DWARF MAMMOTH**—syn. Hairs' Dwarf Green Mammoth—is very closely allied to the preceding, and has doubtless arisen from it. The principal difference is that it is dwarf-fer and somewhat earlier.

§ 6.—*Tall Sorts.*

28, 29, 30. **KNIGHT'S TALL MARROW**—syn. Knight's Pea, Knight's Late, Ridé, or de Knight.—There are three sub-varieties of Knight's Tall Marrow, distinguished by the colour of the seeds when dry, but not differing essentially in any other respect. They are designated (28) **KNIGHT'S TALL WHITE MARROW**, (29) **KNIGHT'S TALL GREEN MARROW**, and (30) **KNIGHT'S TALL BLUE MARROW**. Of strong growth, from 6 to 7 feet high. Leaves large, dark glaucous green. Pods large, broad,

and well filled. The pease are remarkably tender and sugary, more so than in any other variety known; their skin is very thin; and when dry they are wrinkled or indented. If planted not less than 6 feet apart, and supported with tall and strong sticks, these pease will bear most abundantly from the ground to the top: they also bear in succession. They are the best for late crops.

31. **BRITISH QUEEN.**—From 5 to 6 feet high, and an abundant bearer. Pods large, straight, nearly round, generally containing seven very large peas, nearly the size of small beans, indented when dry, and of a light olive green colour. They are larger than Knight's Marrows, but not so sugary.

32. **FAIRBEARD'S CHAMPION OF ENGLAND.**—About 5 feet high, and an abundant bearer. Pods long, somewhat curved, slightly flattened, containing seven or eight large peas, sugary when young, and of a bluish colour when dry. An early variety of great excellence.

IV.—PEASE WITHOUT A TOUGH LINING TO THE PODS.

§ 7.—*Dwarf Sorts.*

33. **DWARF DUTCH**—syn. Dwarf Crooked Sugar, Dwarf Sugar de Grace, Nain hâtif de Hollande, Nain de Hollande.—About $2\frac{1}{2}$ feet high; rather late. Pods small and crooked. It may be cultivated where sticks cannot be afforded for this class of pease.

34. **TAMARIND**—syn. Late Dwarf Sugar.—About 4 feet high, therefore only dwarf as compared with some of the other Sugar pease, that are usually very tall; an abundant bearer, and the latest variety of this class. Pods large, curved, from 4 to 6 inches long; seeds large and white.

§ 8.—*Tall Sorts.*

35. **LARGE CROOKED SUGAR**—syn. Broad-sword, Six-inch Pod Sugar Pea, Sans-parchemin blanc à grandes cosses, Cornes de bélier.—About 6 feet high, and rather late. Pods very large, broad, flat, crooked, something like a ram's horn; tender when young, so that they can be snapped in two like the young pod of a kidney-bean, and are then fit for use. The sides exhibit prominent marks where pushed out by the seeds, even at an early stage of growth.

36. **POIS GEANT SANS PARCHEMIN.**—Tall, with larger pods than those of any other variety of this class. It is the sort most cultivated for the Paris markets.

The sorts above described are much more numerous than any one individual could wish to cultivate; but tastes and circumstances are so different, that it is necessary to afford plenty for selection. No one will affirm that early and late varieties are not required; and it will be admitted that tall and dwarf sorts must be supplied. Again, some prefer small pease, others large; some white, others blue or green. There can be no harm in sowing before winter, early in spring, or at both these seasons, the Early Frame, Waite's Daniel O'Rourke, Prince Albert, Warner's Early Emperor, and the Early Charlton. On the contrary, as there is some difference in these as regards the time of their becoming fit for use, the supply will be better; for these early sorts do not bear long in succession; and, if the whole sowing were to consist of any one of the above, a continuous supply would not be so well insured as would be the case by the several sorts producing in succession. If dwarf sorts are, from circumstances, most convenient for an early sowing, Bishop's New Long-Pod will be the most to be depended on, although some gatherings from the Improved Early Dwarf may be obtained still earlier. To the above, the Auvergne and Dixon's Early Favourite will form a succession of fine white pease. If larger pease are preferred, then the succession may consist of Bellamy's Early Green Marrow, Adamson's Matchless Marrow, and Fairbeard's Surprise.

The Blue Prussian breed is good for summer crops, as they remain longer fit for use than the early white sorts. In this section, Groom's Superb Dwarf Blue and Bedman's Imperial will suit as dwarfs; and the Blue Prussian and Imperial, though not ranked among tall pease, will be improved by sticking. The Scimitar, as already observed, yields a crop which can be mostly gathered at once, and on this account it is desirable in some cases. In § 4 there is a choice of Marrows, which although rather taller than could be properly included among the dwarfs, are, nevertheless, suitable for those who cannot easily procure tall sticks; and for those who can, the Tall Green and the Victoria Marrow will supply late summer pease of the largest size.

In § 5 and § 6 we have Knight's Dwarf and Tall Marrows, which should be sown in large proportion. Fairbeard's Champion of England, as regards height, is intermediate between these, and is, moreover, earlier.

Class IV. is composed of the Sugar pease, the *sans parchemins*, or *mange-tout* of the French. These are destitute of the tough film of skin with which the inside of the pod is lined in pease belonging to the other classes; the pods readily snap over like those of kidney-beans. On the Continent they are cooked so as to form an excellent dish, which is probably a more wholesome one than that supplied either by the French bean or scarlet runner.

Soil.—A rich calcareous friable loam is best for the main crops of pease, in the composition of which lime is a principal ingredient; and if the soil do not naturally contain a sufficiency of calcareous matter, the latter should be added to it in the shape of lime, chalk, gypsum, &c. It should be deep, so that the roots may easily penetrate downwards to obtain moisture in time of drought, otherwise the foliage will be liable to be attacked with mildew. When this is the case, or if the plants get once too dry after they have commenced to blossom, the pods never fill well. For early crops, and especially for the very earliest, a warm, rather sandy loam is desirable, because earliness rather than abundance is the desideratum. The ground in all cases should be well drained, and the surface should be kept so that the rain-water may not run off by it, but pass through the soil.

Manure should be applied in greater or less quantity, according as the soil is more or less poor. In general, pease are sown in ground that has been manured for a previous crop; but for the latest crop it is a good plan to trench the ground, putting a layer of rotten dung about 1 foot below the surface. For early crops horse-dung is preferable, and in moist situations it may be employed in a littersy state when only partially decomposed, so that it may act mechanically as drainage. When soil has not been enriched for a previous crop, and is too poor for pease, good farm-yard manure can always be depended on. With regard to artificial manures, the natural composition of the soil should be ascertained, and, if possible, substances of which it is deficient should be supplied. In calcareous districts it would, of course, be worse than useless to add lime, chalk, or gypsum; but these substances

will, on the contrary, be highly beneficial in all soils where they only exist in very limited quantity. Some artificial manures act injuriously when they are in immediate contact with the germinating seed, and the seed itself doubtless affords the best nourishment that can be given, and till that is exhausted, or nearly so, stimulants of any kind must be either superfluous or injurious. Guano, however, has been found to answer well when mixed with the soil in the bottom of the drill, and then covered with $1\frac{1}{2}$ or 2 inches of soil. When at this distance from the pushing embryo the latter cannot be injured by the manure, and the radicle, when it approaches it, is strong enough to assimilate the nourishment thus afforded. Excellent crops have been obtained with guano applied in a similar manner, and the haulm was shorter and stronger than where no guano was employed; but on Marrow pease, which are naturally inclined to grow too luxuriant, the effect as regards produce was not so good.

Culture.—The ground having been prepared, the first thing to be done is to mark the distances for the rows, and this will depend on the height of the variety, which again ought to be selected according to circumstances. Where the space is limited, or where tall sorts would injuriously shade other things, it may be advisable to select dwarf kinds, or at all events not very tall ones. It has been well ascertained, that rows standing far apart yield the best and most abundant produce. Hence, some have them 20 or 30 feet apart or more, the intermediate space being occupied by other crops. The usual plan, however, is to make the rows from 3 to 6 feet asunder. The very dwarf sorts, not requiring sticks, such as Bishop's New Long-pod, may be sown in rows 2 feet apart; the Early Frame and its sub-varieties, 3 or 4 feet apart; and, as a general rule, the distance between the rows may be made equal to the height to which the variety usually grows. The vigorous-growing dwarf Marrows should, however, be made exceptions, as from their broad foliage they require more space than the slender growing kinds, such as the Early Frame. Knight's Tall Marrow should not be less than 6 feet between the rows, unless when space is very limited, and then the distance may be somewhat less, taking care, however, to top the plants when $5\frac{1}{2}$ or not more than 6 feet high. Some recommend two rows to be sown 9 inches or 1 foot

apart, and then to insert a row of sticks between for both rows of pease to lay hold of, the same distance being allowed between the pairs of double rows as between single ones.

For early pease, the best direction for the rows is east and west. This would be lengthwise along a south border; but it is generally more convenient to sow across the border, and if it be done obliquely from south-east to north-west, the ridge of soil drawn to the roots of the plants will have the sun's rays nearly direct on its broadside when they are hottest. For the main crops in the open quarters, it is considered best to draw the rows from north to south. The average depth of the drills should be about $2\frac{1}{2}$ or 3 inches for small sorts, and $3\frac{1}{2}$ inches for the large kinds. This depth may, however, be exceeded in the case of November and winter sown pease. The seeds are often sown too thickly; and, on the other hand, some direct them to be placed as much as 3 inches apart. This, however, is not advisable as regards quantity of produce from a certain extent of ground, and can only be recommended when the object is to have as much increase as possible from some particular sort of pea, which it may be desirable to multiply. The seed should be tried previous to sowing, and allowance made for the proportion of it that either does not come up at all, or so weakly as not to be reckoned upon. Early sorts may be sown with seeds of a fair sample, at the rate of a pint for 45 or 50 feet of row, or 60 feet for medium growing sorts; and in the case of late strong kinds, such as the Tall Marrows, the same quantity may be allowed for 70 or 80 feet. When the seeds have been sown, the soil raised in forming the drill should be chopped, if lumpy, with the back and teeth of the rake, and then returned on the pease, and it may be trodden lightly, or rolled, if it be not wet. As soon as the plants are a few inches above ground, a little earth should be drawn towards the lower part of the stem, but so as to press very little against the foliage. As the plants advance, some more soil should be drawn towards them. They should then be immediately stuck, if that be at all intended, for it is most injurious to the pea crop to allow the plants to grow till the haulm bends. Once this is the case they will never take up well. By the time the tendrils appear, the sticks should be in readiness for them to lay hold of, and then

they will keep the haulm straight, which is more than can be effected by any propping up after it has been knee'd. When pease are not intended to be stuck, the earth should be drawn more against one side of the row than the other. This will incline all the haulm to the opposite side. Were this not done, some plants would incline one way and some the other, and get into confusion with those in the adjoining rows. It is better to incline the plants when young, than allow them to grow upwards to some considerable height, and then be bent all at once by the force of the wind.

Earliest Crops.—It was formerly an aim in pea culture to have the first gathering as early as the 4th of June, the birth-day of George III. But by various modes of forwarding and protecting, green pease are obtained much earlier in ordinary seasons. To have them, however, in the first week in June, is as early as some can attempt, when means are limited. There may be a south border at disposal, sheltered either by a wall, hedge, or other fence. Taking advantage of such, the first sowing for an early crop may be made about the middle of November, choosing, of course, the earliest sort of pea, or several of the earliest varieties; but enough of each to afford a dish, by taking the one or two most forward pods on each plant. To protect from mice, the seed should be covered with a greater depth of soil than is usual for summer crops; but the nature of the covering should be lighter. The pea will spring through a considerable depth of soil without injury. The seeds when sown may be just covered with some good soil, and then with several inches of sand. The sand would be easily enough worked by mice, but it forms too unstable a roof for their burrows, and by falling in, renders their mining operations in vain. Chopped furze has been employed as a protection, but it is not quite effectual; for mice live snugly enough under furze bushes where old fallen prickles abound. Powdered rosin rubbed over the seeds is said to be a preventive, so is a covering of about 1 inch deep of sifted coal ashes.

Before the pease reach the surface of the ground, the latter should be stirred and made fine, taking care in doing so not to injure the tops of the young plants. When they are a little above ground, earth should be drawn to them, and they ought to be sheltered by sticks, stronger, and placed closer together, on the north than on the south side. On the latter,

indeed, the sticks should be as thinly set as is consistent with preventing the plants from falling, till their tendrils can lay hold of the more substantial sticks, intended for both shelter and support. In quarters, and sometimes in borders, the ground for early sown pease is thrown up in ridges, the bases of which are equal to the distance which the sort of pea would require between the rows, if sown on level ground. Their height may be 2 feet above the bottom, which should be made lower at one end than the other, in order that water may not collect there. In this way the roots of the plants will be free from stagnant water; whilst the pease, being sown about half-way up the slope, will be sheltered by the upper part of the ridge. If the weather and state of the ground permit, another sowing should be made in January, still choosing warm sheltered situations.

Mr. Hardy recommends the first crop to be sown on a southern border and on a northern aspect, both at the same time:—"This insures success either in inclement or mild winters; and sometimes both crops are preserved. In open compartments, let the ground be ridged 1 yard wide; sow both on the southern and northern sides of the ridges. In case of long frost and snow, there are ten chances to one that those on the cold side will be protected, whilst those on the sunny side, deprived of snow, will be destroyed by frost. In mild weather, dredge soot between them, in order to ward off slugs, &c. Sink a pot or pitcher, greased with good lard, and half-filled with water, into the earth up to the brim, as soon as the pease are sown; this will trap all mice."—(*Gardeners' Chronicle*, 1850, p. 726.)

Early dwarf pease are occasionally sown along the bottoms of walls; but it is better not to do so if any other means can be adopted, because they interfere with the performance of operations necessary for the trees. The wooden pales of any inclosure, not immediately connected with the garden, may be taken advantage of, and various other means of shelter may be devised, according to the means and materials at command. In case of severe frost, it is a good plan to mulch near the pease with litter, leaves, or other substances that will prevent the ground from being frozen.

Sowing in Pots.—Pots, where they can be spared for the purpose, afford a very convenient means of forwarding an early crop, as they

can be easily moved from place to place, and exposed to air and light. Various modes of sowing in pots have been recommended; some dispose the pease in a circle by the side of the pot, and on planting out, the ball is opened so as to allow of the circle of pease being extended along the drill. In this way a ring of pease in an 8-inch pot would occupy nearly 2 feet of row. We, however, prefer pots about 3 or 4 inches in diameter. In these the seeds should be sown equally, but not too thickly, and reared in a house or frame, but in all cases near the light, till the state of the weather admit of their being planted out in the open ground. A mild time should be chosen for this operation, and it would be desirable that the wind should be in the south-west; for in that case there would be little danger of frost at night. If turned out of the pots, and planted by means of a trowel, with the balls entire, and about 1 foot apart, and the plants be immediately stuck, the latter will fan so as to fill the rows better even than if the balls were broken and extended, so as to meet each other in the drill. After the sticks are inserted, some spruce branches may be stuck in on the northern side for additional shelter. The plants should be earthed up in the usual way, and stopped above the third or fourth flower.

The Parisian market gardeners, according to Courtois-Gérard, sow in the beginning of November, in frames, placed on a border with a good aspect. They allow about $1\frac{3}{4}$ pint of seed to 52 square feet, and this produces plants sufficient for six or eight frames of that area. The seeds are covered very slightly; the sashes are put on; and when the pease have begun to push, they are covered with a thin layer of fine earth. In the course of December, the frames into which the young plants are to be transplanted are placed, and the ground inside is dug out, so as to be 18 or 20 inches below the sashes, the earth removed being placed against the outside of the frames. After this the ground on the inside is dug, levelled, and raked, and four drills 3 inches deep are drawn lengthwise in each frame, at equal distances; but a greater space should be given between the first row and the front of the frame than that allowed between the rows themselves, because that part is naturally the dampest. The frames having been prepared, the young plants, as soon as they are 3 or 4 inches high, are taken up, but without breaking the roots,

and planted in patches of three or four, placed 8 inches asunder in the row. During frost, the sashes are covered at night with straw mats, and air is given whenever the weather is sufficiently mild. When the pease are 8 or 10 inches high, all the stems are inclined towards the back of the frame, and to keep them in this position, a little earth is drawn to their base. When the plants come into blossom, they are pinched above the third or fourth flower, in order to make them bear the sooner.

Whenever the sun has sufficiently warmed the ground, gentle waterings are given; but this should only be done very sparingly till the pease begin to pod, otherwise a too vigorous growth, which would be detrimental to the crop, might be the result. Usually the pease thus treated produce pods fit for gathering in the first fortnight in April.

When pots cannot be had in sufficient quantity for raising plants for an early supply, the above method may be advantageously adopted. Although every possible care may have been taken to protect winter sown pease from accidents, and the ravages of mice, birds, and other enemies, it frequently happens that the rows have many blanks; and as pease transplant very well, especially when not above 4 inches high, it is a good plan to sow some in a frame for the purpose of filling up vacancies. By this means the ground where, from various causes, only stragglers linger, can be properly furnished with well-conditioned plants.

In the climate of Britain there are few instances in which the temperature is not above freezing during some period of the twenty-four hours; and pease, when the plants are young, will bear several degrees of frost without injury. They may, therefore, be forwarded in any place where they can be protected at night, and that will be sufficient. They may be exposed to the open air and light every day for a sufficient length of time to maintain the foliage in a green state; and with few exceptions they will daily advance, more or less, in growth. If frames are not at command, turf pits could, in many cases, be formed with rods or slender poles laid to support thick straw covers, fitted so as to be easily rolled up or unrolled. Or, the pease may be sown in large pots, a branched twiggy stick, as tall as the plants are intended to be grown, being, at the same time, firmly inserted in the centre of the pot. Instead of a branchy

stick, Mr. Wilson employed moderately strong willows, inserted at the sides of the pot, with courses of small twine run round the willows, and at 6 inches apart. The advantage of this mode is, that the plants can be kept in the pots till the produce is obtained, and previous to that they can be moved to where there is light, and a sufficient amount of heat. Pease, when young, will not bear forcing. Mr. Wilson tried to force them in pits, and in various ways, but found that they would not bear forcing till they are out of bloom, and the pods set; then they will bear it, and be forwarded admirably.

Main Crops.—The sowings for the main crops should be made in March, April, and May, at intervals, which must vary according to the variety employed, and other circumstances. Many sow for succession when the previous sowing appears above ground; but this rule should not be made absolute. For example, a sowing made when the weather is very favourable for vegetation, and on the first appearance of the previous sowing, will almost overtake it, and thus form too close a succession. If sorts are employed that do not naturally form a succession, the sowings will require to be made at intervals of a fortnight or three weeks. The periods which the respective varieties require from the time of sowing till they come into bearing, varies, of course, in different seasons and localities, so that the only way by which a correct knowledge as to those which will naturally form a succession can be acquired, is to try the different kinds, and note the order in which they become fit for use, and then it will be easy to regulate the sowings so as to keep up a succession. The following statement as regards the time which some of the principal varieties require, from the time of sowing in the last week of March, till the pease are fit for use, will afford some idea of the relative earliness of the different sorts. From this, it will be seen that, by selecting certain varieties, more than a month's successional supply can be obtained from one sowing:—

Number of Weeks required from the time of Sowing in the last Week of March till fit for use.

	Weeks.
Prince Albert,	13
Early Frame,	14
Bishop's New Long-pod,	14
Bellamy's Early Green Marrow,	14-15
Fairbeard's Surprise,	14-15
Early Charlton,	15-16

	Weeks.
Flack's New Large Victoria,	15-16
Adamson's Matchless Marrow,	15-16
Blue Prussian,	16
White Prussian,	16
Auvergne,	16-17
Imperial,	16-17
Bedman's Imperial,	16-17
Woodford's Green Marrow,	17
Victoria Marrow,	18
Knight's Tall Marrow,	18

LATE PEASE.—By selecting proper sorts, and adopting a suitable mode of cultivation, pease may be obtained late in autumn, if the weather be tolerably mild. It is necessary that the ground should be well and deeply trenched, and, if dry, it should be thoroughly moistened, particularly the lower portion of it, otherwise the crop is apt to mildew. The ground being so far prepared, shallow trenches should be dug out as for celery, and some good rotten dung laid in the bottom. Part of the soil turned out of the trench ought to be scattered over the dung—then a layer of dung and soil mixed; and, finally, a layer of soil without manure; and in that the seed should be sown. The best sorts for a late crop are Knight's Marrows, of which some prefer the dwarf, others the tall kinds. In warm soils and situations, these may be sown in the second or third week of June; but in the northern parts of the kingdom, the first week will be as late as they will blossom and form pods in any quantity. The tall sorts for late produce should be topped when 4 feet high, and again when they attain the height of 6 feet. The Early Charlton, and the Auvergne, may be sown as late as the middle of July, and may afford a late supply, as they form pods in a shorter period from the time of sowing than the Marrow kinds.

The plants raised from these sowings should be earthed up and sticked in the usual way; and great care should be taken that the extremities of the roots are well supplied with moisture. If the air be hot and dry, the drain of moisture from the soil by the roots will be very great, so that before one is aware, their extremities drain the soil to too great an extent, and then the whole plant must suffer. If once too dry, the evil cannot be effectually remedied, but it may be easily prevented by timely and effectual watering. If the weather continue dry, a good mulching to the distance of 1 foot on each side of the row will be very beneficial.

It is not natural, however, for the pea to vegetate from seed in the hottest period of the season, and then have, consequently, to form its seeds under a great decline of temperature. It succeeds best when sown so that it may progress towards maturity with a rising temperature. Therefore, it is probable that the best plan to obtain good late pease, with the greatest certainty, would be to sow in pots in July, and keep the plants in a rather cool place till they have nearly advanced to a flowering state, and then remove them to a warmer situation, such as that in front of a south wall. In this way they would be kept comparatively cool during the early period of their growth; and although the heat would decline as they advanced to flowering, yet to them the effects would be in a great measure counteracted by a removal from a cool to a warm aspect, where the plants would be exposed even to an increase of temperature compared with that in which they had been reared.

To save Seed.—In order to have well-matured seeds, the crop should be sown at the most favourable period, for the uniformly progressive growth of the plant. If sown too early, the plants suffer from a too lingering vegetation, and on the other hand, if sown in the heat of summer they suffer still more from being stimulated to make too rapid growth, or from drought. The best time to sow for a seed crop is intermediate between these extremes, namely, in March. Early sorts, such as the Early Frame and Early Charlton, are more apt to be attacked by certain insects than later kinds, which are supposed to escape from not coming into flower till the insect has changed. On this account, it may be advisable where early sorts are attacked to sow them later, so as not to come into flower when the insects are abundant.

Insects, &c.—Pease are attacked by numerous enemies—mice, birds, and the snake millepedes eat the seeds deposited in the ground. The young plants, as soon as they appear above it, are cut off by snails, slugs, and by the pea-wcevils, *Sitona crinita*, *S. lineata*, and *Otiorhynchus picipes*. The caterpillars of the Y-moth (*Plusia gamma*) feed upon the leaves, which are also mined by the maggots of a minute fly, *Phytomyza nigricornis*. Birds and the pea-maggots, which are the offspring of a moth called *Grapholitha pisana*, attack the pease in the pods. Lastly, the interior of the seed-pease are eaten out by the maggots of *Bruchus*

granarius, and in North America the pea-beetle (*Bruchus pisi*) proves very destructive in the same way. Pease are also subject to be attacked by the mildew (*Erysiphe communis*), which appears to be induced by a defective supply of moisture. This disease may be prevented by copious waterings, and kept under by dusting with sulphur.

PENNYROYAL. See MINT.

PICRIDIVM VULGARE, Desf. (Syngenesia Polygamia Æqualis, L.; Compositæ, D. C.; Asteracæ, Lind.)—is an annual plant, a native of the south of France, which has been introduced into the French kitchen gardens through the exertions of M. Vilmorin. The leaves, cut when young and tender, furnish a salad much esteemed in Italy, and which is said to be mild and good, partaking slightly of the flavour of a leg of mutton. It is sown in a warm situation in March or April, and in succession throughout the summer and autumn. In summer, it should be sown in a shady situation, and watered frequently. The leaves from each sowing may be cut several times, as fresh ones are produced after cutting.

POTATO (*Solanum tuberosum*, L.—Pentandria Monogynia, L.; Solanæ, D. C.; Solanacæ, Lind.)—The potato is a perennial plant, with a tuberous subterranean stem; a native of the western coast of South America, where it is found wild under widely different conditions of soil and climate—on dry sterile mountains, and in damp forests near the sea. It is generally supposed to have been introduced into England, from Virginia, by Sir Walter Raleigh, in 1586. According to Sir Joseph Banks, it also appears to have been brought to Spain from South America in the early part of the same century, and from that country it was carried into Italy and Germany. It was only towards the end of the eighteenth century that the potato began to be extensively cultivated in Britain; and from that period it rapidly advanced in favour till it became an important article of food to all classes of the community, and the principal support of the people of Ireland; and even since the appearance of the destructive disease with which the plant has of late years been attacked, it still is, and probably ever will continue to be, a crop of the greatest importance to the people of that island.

The composition of the potato varies considerably, according to the variety cultivated, the soil in which it is grown, and various

other circumstances; but the average composition, as deduced from numerous analyses by Fresenius, is as follows:—

	In Natural State.	In Dry State.
Albumen,	2.43	8.41
Starch,	15.00	51.89
Gum and organic acids,	3.30	11.42
Fatty matters,	0.10	0.35
Fibre,	7.00	24.22
Asparagine,	0.10	0.35
Ashes,	0.97	3.36
Water,	71.10	...
	100.00	100.00

The proportion of nitrogenized, non-nitrogenized substances, ashes, and water, has been determined by Horsford and Kroecker with the following results:—

	White Potatoes grown at Giessen.		Blue Potatoes grown at Giessen.	
	Natural State.	Dry.	Natural State.	Dry.
Nitrogenized, or flesh-forming constituents, ...	2.49	9.94	2.37	7.63
Substances not containing nitrogen, and fitted to support respiration, or to lay on fat:—				
<i>a</i> , Starch, sugar, &c.,	18.00	71.86	23.00	74.05
<i>b</i> , Fibre,	3.66	14.61	4.65	14.97
Ashes,	0.90	3.59	1.04	3.35
Water,	74.95	...	68.94	...
	100.00	100.00	100.00	100.00

The composition of the ash, as calculated from the analyses of five different varieties made by Mr. T. Herapath, is as follows:—

Potash,	54.401
Soda,	traces.
Chloride of sodium,	0.419
Carbonate of lime,	2.030
Carbonate of magnesia,	1.639
Sulphate of lime,	0.025
Phosphate of lime,	3.222
Phosphate of magnesia,	8.052
Phosphate of iron,	0.012
Phosphate of alumina,	traces.
Phosphoric acid,	7.301
Sulphuric acid,	4.748
Silicic acid,	0.025
Carbonic acid,	18.124

100.000

Per centage of ash,

1.1221

From the above analyses, it appears that the potato supplies nearly all the substances required for the nourishment of the human

frame, and that it is a good supporter of respiration, and well fitted for the production of fat; but greatly inferior to pease, beans, and all sorts of corn as food. The comparatively small amount of nitrogenized matter which it contains, renders it of little value for the formation of muscle, and incapable of supporting prolonged muscular exertion, unless consumed in greater quantity than can be digested by ordinary men. It is to this circumstance that the disinclination to labour, remarked in those who live almost exclusively on a potato diet, is, probably, in great measure to be ascribed. In confirmation of this view, it may be remarked that the Irish labourer in England, where he obtains food containing a large proportion of flesh-forming matter, easily performs work of the most laborious description. Another circumstance worthy of remark is, that milk, in which the flesh-forming, or nitrogenized matters predominate, is frequently used along with the potato, and this would seem as if nature taught the rude peasant how to supply the deficiency of these highly important elements of nutrition.

The *varieties* of the potato were exceedingly numerous previous to the outbreak of the disease which universally attacked them. Their characters till then were generally permanent, but the disease appears to have completely destroyed a large portion of these varieties; for nothing is now heard of them, whilst the characters of others, which have escaped total destruction, seem to have been greatly altered. This being the case, particular descriptions can not be well attempted, until the absence of the disease allows the plants to return to their normal condition. We shall therefore only name a few of those which are most approved of for garden culture at the present day. These are:—*Early Sorts*—Ash-leaved Kidney, Early Manly, Rufford Kidney or Lady's Finger, Fox's Seedling. *Second Earlies*—Cornish Kidney or Chapman's Lawhead Early White, and Early Red, Fluke Kidney, Rylot's Flower Ball, Fifty-fold Kidney. *Late or Main Crop*—Lapstone Kidney, York Regent.

Of the above sorts, the Ash-leaved Kidney is the one generally employed for forcing, and for the earliest border crops. It is preferred on account of its form and appearance to the Early Manly and similar round varieties. The Cornish Kidney is well adapted for a particular mode of treatment, by which, previous to the disease at least, a tolerably good substitute

for forced potatoes during winter was obtained from late grown tubers packed in earth.

Soil.—The best soil for the potato is a naturally good friable loam, rather light than otherwise, and free from stagnant water. In such soil the produce is abundant, and the quality good. Thin sandy soils also produce well-flavoured potatoes, but of course to obtain quantity of produce, the assistance of manure is necessary. The worst soils for the potato are those which are naturally wet and heavy, and those which have long been cropped and heavily manured; hence, garden ground, in most cases, does not produce tubers of so good quality as those obtained from the fields. It is therefore not advisable to occupy the garden with any but early kinds, if the general supply can be obtained from the fields.

Manure.—In good garden soil, the less manure that is used, the better flavoured will be the produce; and it will also be much less affected by the disease. Therefore, whilst the malady prevails, or symptoms of it still remain, it is not advisable to apply much manure. It is to be hoped, however, that the disease will soon disappear, and that the plant will return to its former state of health; and in that case it would be desirable to know what kinds of manure have proved beneficial.

Amongst the manures that have been employed for the potato may be enumerated stable yard manure, horse, cow, and pig dung, leaves, leaf-mould, peat ashes, wood ashes, peat charcoal, and other carbonaceous substances, lime, gypsum, bone-dust, superphosphate of lime, sulphate of ammonia, sulphate of magnesia, sulphate of soda, nitrate of soda, and common salt.

Farm-yard manure spread along the bottom of the furrows, and the sets placed upon the manure, is a very common practice. Many prefer planting the sets, and then laying the dung over them. Where dung is scarce, and the soil poor, these modes of application may be advantageously pursued; but in ground so rich as that of most gardens, the manure may be dug in equally, and in this way the crop is considered to be better flavoured than when the dung is more immediately applied to the roots. Long dung is good for moist loamy soils, and fresh littery stable dung is suitable for early crops. Farm-yard manure, together with wood ashes, has been found to answer well as regards quantity of produce, whilst the ashes lessen the tendency to disease. Cow-

dung is a more lasting manure than horse-dung, and is considered better for late sorts in warm, dry, sandy soils, as it retains more moisture. It should be well mixed with litter, and be placed below the sets, so as not to be in contact with the young tubers, otherwise it is apt to make them scab. The same remark applies to pigs' dung, which should be either well mixed with the soil, or formed into a compost with earth previous to planting.

Leaves make a good manure, and where the soil is damp and heavy they are of advantage in keeping the ground open, when used in an undecomposed state. They may be placed under or over the sets, or both, or distributed equally throughout the soil in digging, but they should be turned over and thoroughly wetted before they are dug in, for, if turned

into the soil in cakes, they are apt to remain in that state and become musty. Wood ashes are useful for supplying potash and other inorganic substances required by the plant; and they may be advantageously applied where the soil contains a large amount of decayed vegetable matter. The same remark will apply to lime, which is also useful in killing slugs and other vermin which attack the tubers. Gypsum, bone-dust, and superphosphate of lime are best for humid soils; they induce earliness, and where this is an object, as it must be whilst the disease continues, they may be applied with considerable advantage.

From experiments made in the garden of the Horticultural Society of London, with thirty different substances as manures for the potato, the following results were obtained:—

Manure.	Whole produce per Acre.			Increase per Acre.			Large Tubers.			Increase per Acre.			Whole Haulm.			Increase per Acre.		
	tons.	cwts.	lbs.	tons.	cwts.	lbs.	tons.	cwts.	lbs.	tons.	cwts.	lbs.	cwts.	lbs.		cwts.	lbs.	
None,	11	7	109	...	...	...	10	4	105	...	...	...	6	39		...	...
Phosphate of ammonia, ...	13	2	6	1	14	9	11	16	78	1	11	83	9	0		2	73	
Sulphate of soda,	13	6	111	1	19	8	12	4	74	1	19	81	8	4		1	77	
Sulphate of magnesia,	13	19	94	2	11	97	13	0	61	2	15	68	8	71		2	32	
Sulphate of ammonia,	14	9	105	3	1	108	13	6	101	3	1	108	8	27		1	100	
Muriate of potash,	15	0	55	3	12	58	14	1	22	3	16	29	10	69		4	30	
Common salt,	15	2	72	3	14	75	13	18	2	3	13	9	11	35		4	108	
Nitrate of soda,	15	9	89	4	1	92	14	1	22	3	16	29	10	36		3	109	
Muriate of ammonia,	17	1	75	5	13	78	16	15	7	6	10	14	15	77		9	38	

The potatoes were of the bread-fruit variety, the sets were as nearly as possible of the same size, and were planted on the 20th of March; and on the 12th of May, when most of the young plants were from 2 to 4 inches above ground, the manures were sprinkled as uniformly as possible on each side of the row of young plants to a distance of about 6 inches. The crop was taken up in the middle of September.

In the year 1844 experiments as to the effects of various manures on the potato crop were again undertaken. The potatoes, which were of the bread-fruit variety, were cut into

sets, and planted on the 3d of May, in rows 2½ feet asunder, about 7 inches apart in the row, and 6 inches deep. After having been mixed with about 7 parts of fine soil, the guano manures were scattered along the bottoms of the trenches, and then watered from the rose of a watering-pot. The crop was taken up and weighed on the 21st of October. Many of the tubers were injured by slugs, and on that account the relative amount of total produce will afford the best criterion by which the comparative value of the manures experimented upon can be judged, as far at least as can be done from the results of a single trial:—

Substances applied as Manures.	Rate per Acre.	Approximate cost per Acre.	Produce per Acre.						Total Produce per Acre.		
			Large.			Small or Damaged.					
	cwts. lbs.	£ s. d.	tons.	cwts.	lbs.	tons.	cwts.	lbs.	tons.	cwts.	lbs.
1. Guano F, <i>Gibbs'</i> ,.....	4 5	2 4 6	12	10	86	5	3	91	17	14	5
2. Potter's artificial guano,.....	4 5	2 10 6	15	2	0	2	0	50	17	2	50
3. Charcoal dust,.....	75 bush.	6 0 0	10	14	104	5	18	72	16	3	64
	cwts. lbs.										
4. Sulphate of magnesia,.....	16 20	7 10 0	10	10	36	5	7	96	15	18	20
5. Bone-dust,.....	16 20	9 0 0	8	9	98	5	18	72	14	8	58
6. Bone-dust,.....	10 88	6 0 0	7	2	102	6	14	14	13	17	4
7. Sulphate of magnesia,.....	10 88	5 0 0	10	4	104	2	19	36	13	4	28
8. No manure, .....	...	...	10	15	80	1	6	108	12	2	76

It appears from the above that guano, marked F, from Gibbs, afforded the most profitable return after allowing for the cost of the manure, and next to it Potter's artificial guano.

In some experiments carried on by Mr. Fleming, of Barochan, a mixture of one-third of nitrate of soda with two-thirds of sulphate of soda, applied as a top-dressing at the rate of 200 lbs. per acre, to potatoes grown in ground manured with 30 cubic yards of dung, had a wonderful effect, increasing the produce as much as 60 per cent., and gave a much better crop than either salt applied by itself.

The proper selection of manures must depend on the nature of the soil, the climate, and the variety cultivated. In soils where the haulm grows too luxuriantly, no manure, or at all events none that would increase that luxuriance, should be applied, especially if the climate is moist. Superphosphate of lime would probably be the best application under such circumstances. Varieties naturally dwarf will bear ammoniacal manures better than those that are naturally tall.

Propagation.—Potatoes are easily propagated by seeds, cuttings of the stem or branches, by planting whole tubers, or by those cut into sets. The seed should be sown early in spring, in pans filled with rich light soil, placed in moderate heat. Before the young plants get crowded, they should be pricked out into small pots, and shifted as they require it; or they may be planted in rich soil under a frame with very slight heat, giving them plenty of air in fine weather, and more or less at all times when there is no danger of frost. The plants should be fully exposed before planting out, which had better be deferred till fine weather in May. They ought to be planted in a rich warm border, putting a little leaf-mould below them, if it can be afforded, to assist their rooting. Afterwards they should be earthed up according to their strength. Some small tubers will be produced the same year; and these, planted in the following spring, will produce good-sized tubers. Seeds from the same individual will produce very different varieties, and hundreds of such have been raised since the prevalence of the disease. If neither glass nor artificial heat is at command, the seeds may be sown on a warm border.

Propagation by cuttings may be successfully resorted to for increasing any particular variety. For example, the original tuber may

be cut into sets, planted early in spring, in heat, and the shoots cut off near their bases when they have reached a finger's length, and planted deeply in rich soil. Fresh shoots will push again and again from the original sets, and may be treated in the same way. Propagation by planting the tuber, or parts of it furnished with eyes, is, however, the mode usually employed.

With many it is a doubtful question whether whole or cut tubers yield the greater return. From experiments made in the garden of the Horticultural Society at Chiswick, it was found, on the mean of two plantations, one made in March, and the other in April, that the produce from cut sets exceeded that from whole tubers by nearly 1 ton per acre. In the April planting the produce from whole tubers was somewhat greater than that from single eyes; but in the March plantation the cut sets gave nearly 2 tons per acre more produce than the whole tubers, the weight of potatoes planted being deducted in every case.

Another important consideration is, whether *small* tubers or *large* ones should be employed for making sets; for, if by using the former an equally good crop could be obtained, a considerable saving in the expense of sets would be effected. Large tubers, however, are preferable, for the following reason:—In all plants large buds tend to produce large shoots, and small or weak buds the reverse. Now, the eyes of potatoes are true buds, and in small tubers they are comparatively weak; they consequently produce weak shoots, and the crop from such is inferior to that obtained from plants originating from larger tubers, furnished with stronger eyes; and this conclusion has been justified by the results of actual experiments.

The part of the potato employed for sets is not a matter of indifference. It was found by an experiment made in the garden of the Horticultural Society, that sets taken from the points of the tubers, and planted in March, yielded at the rate of upwards of 3 tons per acre more produce than was obtained from employing the base of the tubers. In a plantation made in April the difference was much less, but still in favour of sets from the points or top ends of the potatoes. Cottagers may therefore use with advantage, say two-thirds of the base of the tuber, and put aside the top for sets.

Mode of Cutting the Potato for Sets.—The

potato should be held with the top end upwards. The eyes at the base are few as compared with those at the top, and they are also sometimes blind, or so weak that they do not push. They should therefore be closely inspected; and in cases where the development of an eye is suspected, it will be advisable to cut the set so that it may have two eyes. Sorts which have the eyes almost level with the general surface are most apt to be blind. As the base of the eye slants downwards towards the centre of the tuber, the knife should be entered above the eye, and the cut should slant downwards towards the centre, and parallel to the direction of the base of the eye. In this way the portion of tuber containing the lowest good eye must be detached; then turning the potato round, the knife should be entered above the next higher eye, and with it a similar portion should be taken off. Proceed thus till near the top, where the eyes are so numerous that if each were cut into a set, the latter would be too small; but this may be done in cases where it is desirable to multiply some particular sort as speedily as possible; or, in other words, to obtain a numerous return, irrespective of size or weight. A small portion containing a number of these top eyes, is therefore usually pared off, so as to leave only one or two to a moderate portion of tuber. In times of scarcity, recourse has been had to merely scooping out the eyes for sets, or stamping them out with a hollow punch, the bulk of the potato in either case being left for food. By early planting in well-prepared soil, good plants can be reared by this mode, especially if the early part of the season prove favourable. It appears from experiments recorded in the *Transactions of the Horticultural Society*, that cut sets planted in March produced a better crop than similar sets planted in April, although the produce from whole tubers planted at these periods was the reverse. From this it may be inferred, that when only small portions of the tuber accompany the bud, the planting should be performed as early in spring as the state of the weather will permit. If the weather or state of the ground be unfavourable, the small pieces for sets may be placed with the buds upwards, in soil under cover till they can be planted out in the open ground. Potatoes intended for sets are considered better if exposed to the light, when taken up, until they become green throughout; they are then

stored in a dry place till the time of planting. It is thought that this proceeding has the effect of increasing their powers of vegetation, and renders the plants less subject to disease. Others cut the sets and dry them before planting, but this does not appear to be of any advantage; on the contrary, many of the dried sets do not push at all, and others but weakly. A change of sets is advantageous. Instead of using tubers produced for many years successively in the same soil, and in the same locality, it is found advantageous to obtain sets grown in a different soil, or in a different part of the country, or both. Mr. Ewing, of Crieff, Perthshire, states (*Gardeners' Chronicle*, 1845, p. 248), that in his part of the country "it has been the general practice, for a good number of years back, to get seeds [sets] from the higher districts of the county, confirming the opinion that the less ripe potatoes are, the better seed do they make." That it is profitable to procure sets from a higher part of the country is highly probable; indeed, if it were not so, it is not likely that it would have been made a general practice for a number of years. We do not, however, concur in the opinion, that it is in consequence of the potatoes grown on high ground being less ripe that they prove better for sets. The potato cannot produce good tubers unless its foliage be well exposed to light; for it is by the agency of light that all the secretions are formed. The superiority for sets of potatoes grown in elevated situations is, therefore, probably to be attributed to the plants being well exposed to light, rather than to the imperfect ripening of the tubers. The potato may suffer in its vegetative powers from either too much or too little moisture; but as regards light, it does unquestionably suffer from too little of that agent—certainly not from too much. Tubers grown in shaded situations are of bad quality as compared with those produced in the open fields, all other circumstances being the same. On elevated ground the plant is exposed to light from almost an entire hemisphere. In such a situation the plant is most favourably circumstanced, as far as the agency of light is concerned. The question is, whether, in a low but warm situation, where the plant makes a rapid growth of long straggling stems, from not being fully exposed to light, the tissues are as perfectly formed as in plants grown in an elevated situation, in a lower temperature, but more exposed to light,

under the influence of which the plants form strong stems capable of maintaining themselves erect. In the latter case, the buds on the stem above ground produce substantial shoots; and, that being the case, there is every reason to believe that the buds on the tubers below ground will also produce vigorous shoots when circumstances admit of their development. We therefore conclude, that sets are best from tubers grown in elevated situations, not because they may happen to be more watery than those grown in low ground, but from the plants having had the advantage of a greater share of light; and as it is admitted that a change of sets is beneficial, that change should be from high open situations to such as are lower.

Time and Manner of Planting.—The usual time of planting is spring, and the earlier the better, provided the ground is in proper working order. If this be the case in the end of February, so much the better; but at all events the planting should be done by the 1st of March, or as early in that month as circumstances will permit. The late Thomas Andrew Knight paid much attention to the cultivation of the potato, and with great success. With regard to the period of planting, he says, "I have uniformly found that to obtain crops of potatoes of great weight and excellence, the period of planting should never be later than the beginning of March."

Autumn planting has been recommended as a preventive of the disease; but, if the potatoes are kept in contact with soil of nearly the same temperature as the ground, they will be in much the same circumstances as if they were planted, only more secure from the injurious effects of frost and saturation. Besides, the ground when dug and planted before winter, and afterwards drenched and beaten by the winter rains, cannot be in such good condition for the progress of the roots as that which is newly prepared at the time of planting in spring.

The distance apart at which the sets should be placed depends on the richness of the soil, the habit of growth of the sort planted, and on the situation as regards exposure to light. The richer the soil the taller the variety; and the less exposed the situation is to light, the greater should be the distance between the rows. According to these circumstances, the rows ought to be from 15 to 30 inches apart. Mr. Knight was of opinion that the distance

of the rows from each other should be equal to the height of the stems. Hence, those which grow only 6 inches high, would be 6 inches apart, and those which attain the height of 3 feet should be, accordingly, 3 feet apart. As regards exposure to light, this is a good rule; but rows only 6 inches, or even 1 foot apart, do not admit of being properly earthed up, and this consideration must not be overlooked. If soil be taken from between the rows to form the ridge in earthing up, it can scarcely be done properly if the rows are only 1 foot apart. Sufficient earth could be introduced between the rows from alleys or adjoining spaces left for the purpose, but it is better to make the rows not less than 15 inches apart, even for dwarf early sorts. Those which are somewhat stronger growing, and later, may be allowed 18 inches between the rows, or 21 inches if the soil is rich, and the situation not fully exposed to light. In light soil, 2 feet for second early crops may be considered sufficient. For the general crop, 27 inches between the rows has been found a good distance, and one which admits of the plants being earthed up on a good principle. In rich garden soils, the kinds of potato which have tall luxuriant stems, requiring a wider distance than that above-mentioned, should not be employed; such varieties are better adapted for cultivation in the open fields.

The distance between the sets in the rows should be regulated by the nature of the soil, and the vigour of the variety. In rich soil, of course, more space should be allowed than in poor; and considerably more for vigorous growing sorts than for those with small dwarf stems. In consideration of these circumstances, the distance between the sets may vary from 6 to 12 inches. The less distance will be proper for the dwarf sorts; the greater for the strong growing ones. In general, 8 inches from centre to centre of the sets will be found a very good distance for garden crops. In the case of very strong growing kinds, it cannot be denied that quite as much produce may be obtained at 12 or 15 inches apart as at 8 inches; but, when the plants have much space, they are apt to produce tubers varying greatly in size, some of the first formation being too large, while those of a later production are too small. In neither case are the tubers so good as when there is a more equal and middle-sized crop; and it should

therefore be the aim to obtain a crop of this description. If a sort is naturally inclined to grow too large, it is well to plant it rather closely in the row; and it is better to do this than to limit the distance between the rows. It is much better to have the rows 27 inches apart, and the sets 8 inches asunder, than to have the rows 24 inches apart, and the sets 9 inches from each other; and this, again, is preferable to rows 18 inches asunder, and sets 12 inches from each other. In either of these ways, the same number of sets will be required to plant a rod of ground; but there is, in the greater distance between the rows, and the less distance between the sets, a double advantage: first, as regards the labour in planting, and, secondly, in a greater space for earthing up being afforded. When planted at the distance of 27 inches from row to row, the number of trenches required to be cut out is one-third less than when the rows are 18 inches apart; and when planting by the dibber is adopted, one-third more ground has to be traversed. The advantages in earthing up will be noticed when that operation comes to be considered.

In general, about 6 inches is a proper depth for the sets. In strong, rather heavy soils, that depth ought not to be exceeded; but in light sandy soils, good sets may be placed 7 inches deep. The following experiment was made in the garden of the Horticultural Society of London, to try the effects of different depths of planting:—A quarter was divided into four equal parts, and planted with sets in the second week in April, at the respective depths of 3, 4, 6, and 9 inches. The results computed for an acre are as follows:—

Depth. Ins.	Produce.		
	tons, cwt. lbs.		
3	13	0	14
4	14	1	18
6	14	11	4
9	13	0	111

The greatest produce was from the plantation 6 inches deep; and next to it, from that at 4 inches. Those planted only 3 inches deep gave the least return. Many of the sets buried 9 inches did not vegetate, or at least failed in reaching the surface. This was also found to be the case by Hasler Hollist, Esq., in 1835, when he adopted the mode of deep planting. The results of his experiments are detailed in the following note:—

"I have this year renewed my experiments on the potatoes you sent me in 1833 from Mr. Knight's collection. I planted in the latter end of March, and at intervals during the whole month of April, but I am satisfied I was, contrary to the received opinion, too early in some instances.

"I also planted at various depths, 9 inches, 7 inches, and from 5 to 6. In nearly every instance the shallow planting has succeeded, but in none the deepest, and in the latter case many of the sets have not vegetated at all; many more have not reached the surface."

As a precaution against frost, autumn-planted potatoes should be planted fully 7 inches deep; or if more shallow, the rows should be covered with leaves, fern, litter, or other protecting material.

Potatoes are planted in various ways; but the modes usually adopted in gardens are in trenches cut out by the spade, or in holes made by a blunt dibber. The former mode is, in our opinion, the preferable one; the soil for potatoes cannot be too loose, and the trench mode has, in this respect, a great advantage over that in which the dibber is employed. In planting in trenches, if the ground requires no manure, let an opening be taken out along one side of the quarter in the direction of north and south, or nearly so, next dig a breadth equal to rather more than half the distance between the rows, then stretch the line at the half distance from the edge of the quarter, and cut down by the line to the depth of 6 inches, or to whatever other depth the sets are to be put. Level the bottom of the trench so that its depth may be tolerably uniform, and then place the sets, with the eyes or buds upwards, in a line along the bottom, at the proper distance asunder, and cover them with some well-broken soil. After this, dig another breadth, levelling the surface at the same time, and stretching the line at the distance which is to be allowed between the rows; cut out another trench, plant the sets as before; and so proceed till the whole is completed. If dung is to be used, the trenches must be cut a little deeper than where no manure is employed. In digging, a good wide opening should be maintained, and in cutting off by the line, the workman should draw the soil well forward, so that the bottom of the trench may be wide; if 1 foot wide so much the better, but it should be as wide as the breadth of the spade. It is preferable to have dung spread on this breadth, instead of

confining it within a narrow triangular trench, thereby crowding too great a depth of manure immediately under the roots of the plants, which is objectionable, as the potatoes produced when this is the case are not so clean. In order that too much manure should not be in any one place, some prefer distributing it as equally as possible throughout the soil; but in that case much of it will come in contact with the newly formed tubers. These do not require it; on the contrary, the poorer the soil the cleaner they grow. On this account it is considered better to place the dung under the sets than over them, as some recommend. Besides, the fibres of the roots tend downwards after nourishment, and if the manure is placed below the sets, they will soon find it; the runners do not seek after nourishment, they cannot feed themselves, but are fed by the roots through the medium of the stem and leaves. After the dung is spread along the bottom of the trench, it is advisable to throw some soil over it previous to placing the sets, for these are liable to be injured by being placed in contact with manure, from which they can derive no benefit. All that the sets can effect is to yield up their own substance to support the vegetation of the young shoot till the latter is able to obtain nourishment from other sources. By the time the sets are exhausted, the fibres of the roots will have reached the manure, which will then afford the necessary supply.

Planting by means of a dibber is extensively practised, and is, perhaps, the most expeditious that could be adopted, except where the plough can be employed. The mode of proceeding is very simple. A blunt dibber, having a cross tread rather further from the end than the depth at which the sets are intended to be planted, is used by one person to make holes, whilst another drops in the sets, so that the eyes of the cut sets may be uppermost. The holes are afterwards filled up with earth drawn by the hoe. Expedition, however, is the only advantage which can be claimed for dibber planting over planting by the spade as already described. By the latter mode, the ground when the operation is finished is left untrodden, and of equal looseness, a great advantage, especially in moist ground. In a trench made by the spade, the sets can also be placed at an equal depth. In planting by the dibber, moist soils are rendered too compact by the treading in performing the operation; and, if the soil be

dry and light, the earth falls more or less into the holes, and the sets are, consequently, at unequal depths. For these reasons, we consider that planting by the spade is preferable to that by the dibber for garden crops of potatoes; and it will be found, that the advantages with which the former method is attended will more than compensate for the trifling saving of time effected by adopting the latter.

In some parts of the country, and particularly in Lancashire, the ground for early crops is thrown up in ridges before winter; in spring a portion of the pulverized soil from the surface of the ridges is collected in the bottom of the furrows; a little manure is placed over this, and the sets are planted upon it, and covered with 2 inches of soil. When the young plants appear, another 2 inches of soil is added, and 2 inches more when they again make their appearance.

Subsequent Culture.—This consists in stirring the surface of the ground, keeping it clear of weeds, and earthing up the plants. The ground cannot be too loose; the more it is pulverized the better. It is a good plan to hoe it over, when not too moist, before the shoots reach the surface; and again before earthing up, if it is not naturally friable. As regards the growth of the plant, and bulk of produce, this operation is unnecessary in deep, light soils; for the roots are, in general, found below the level of the original surface of the ground, so that they do not derive any benefit from the operation. On the other hand, in dry seasons and dry soils, the crops from plants earthed up have been lighter than where they have not been earthed up, probably owing to the earth being drawn to a sharp ridge, by which the rain is thrown off beyond the roots. When properly done, however, earthing up is advantageous, and even necessary for the kinds of potatoes which have a tendency to throw their tubers above the surface. About ten days or a fortnight after the plants have appeared above ground, a little earth should be drawn towards the stems, but not so as to cover the foliage, or interfere with its free exposure to light. If the soil is not very moist, and the season dry, this earthing up should be highest at the outsides, so that in consequence of the slope towards the plants the rain may penetrate to the roots; and the earth should not be drawn so as to leave the interval deepest in the middle, otherwise the rain water would run there, instead of to the roots. On

the other hand, where there is too much moisture, the earth should be made to slope from the plants. As these advance in growth, the intervals between the rows should be stirred, and made fine, in order to render it suitable for the second and final earthing up. The principal use of this is to form a covering for the tubers, so that with their increase in size they may not be exposed to light, which would soon render them unfit for human food, though good for sets. The soil should therefore be drawn not so as to form a triangular ridge, with straight sloping sides, through which the tubers would be apt to protrude, but, on the contrary, broad-shouldered ridges, as wide at top as they can well be made. Their height will partly depend on the distance between the rows, and partly on the depth of the roots. If the former is limited, no great amount of earth can be obtained; and such is also the case if the roots are near the surface.

Some recommend the flowers to be removed previous to the formation of the berries; others contend that the operation is injurious. Mr. Knight was in favour of the practice, and considered that by adopting it, as much as 1 ton per acre more produce would be obtained. On the other hand, the results of several experiments, not very conclusive it is true, are adduced as evidence against the proceeding. There is no doubt, however, that the berries are formed at the expense of organizable matter, which would otherwise have been employed in increasing the size of the tubers; and it may therefore be concluded, that the removal of the flowers is beneficial, at all events, no harm can result from the operation if not performed too soon.

To forward Early Crops.—This may be done in various ways, even by those who cannot spare frames for regular forcing. The tubers can be placed in a warm place, in January, and kept there till they push. They may then be planted in some sheltered situation, where they can be protected with litter, fern, or other substance that will serve as a protection. Dwarf early sorts may be forwarded in pots in any warm place, and when above ground they should be exposed to light and sun when there is no danger of frost. In March they may be planted out in front of a wall or paling, where they can be protected in case of severe weather. They may also be planted in some warm spot, in beds with dry turf sides, about 1 foot or 15 inches high,

over which thatched hurdles can be placed at night, or as the state of the weather may render necessary.

To have Young Potatoes in Winter.—Select a middling early sort, such as the Cornish Kidney, and let the tubers be kept in a cool dry place, on a hard bottom, and frequently turned, so as to check the vegetation as much as possible till the end of July or beginning of August. If then planted, tubers will be formed before winter, which should be taken up and packed in dry soil, closely beaten. Kept in this way they will form in winter a pretty good substitute for forced potatoes.

The following is another method:—Tubers of the preceding year's growth are kept in a cool place till autumn; care is taken to prevent vegetation as much as possible, and all sprouts are taken off as they appear. About three months before a supply is required, the old tubers are piled up in alternate layers with light garden soil, laid to the thickness of 5 or 6 inches, in a cellar, or in boxes placed in any spot where there is a temperature of 50° or 60°. By this process, although no leaves are produced, small tubers are formed out of the substance of the larger ones; but, as might be expected, the produce is vastly inferior in quality to forced potatoes.

Taking up and Storing the Crop.—Early crops, of course, are taken up as soon as they are fit for use. Before the disease attacked the potato, the main crop for storing was allowed to remain till the stems and foliage withered from natural decay. After this had taken place, and before there was any danger from frost, was considered the best period for taking up. Such it still would be if there were no attack of disease to arrest prematurely the vegetation of the plants, and render it necessary to remove earlier than usual the tainted crop of tubers. Dry weather is, of course, the most favourable for the operation; if cloudy so much the better, for the tubers should be exposed to light as little as possible, and more especially not to bright sunshine. It is well known that all the green parts of the potato are more or less poisonous, and so the finest white floury potatoes become, if greened by exposure to light. Potatoes may be white, black, or purple, externally, and their flesh, notwithstanding, be very white and good; but expose them to the light for a longer or shorter period, according to its intensity, and the flesh of all will become green

and unwholesome. Some persons dig up their potatoes, and leave them exposed to the sun's rays to dry, previous to storing; but this is a bad practice, for three days of bright autumn sun will green newly taken up potatoes to a very injurious extent; and this being the case, the tubers should not be exposed to the sunshine even for a single day. As for the necessity of drying potatoes that are to be pitted in the soil, there is none; for we have seen potatoes as wet as possible put into pits, small ones it is true, without any bad effect; and when uncovered in the following spring they were quite dry. It should always be borne in mind, as a general principle in the management of potatoes, that, from the time they are taken out of the ground till they are to be cooked, they should be exposed to light as little as possible. If, after having been dug up, they must lie on the ground in heaps for but one day, or even less, they should be completely covered from light till they are pitted. If stored in a shed, loft, cellar, or any other place, light should be entirely excluded; if in a building, to the interior of which light must be admitted, it should, nevertheless, be prevented from reaching the tubers by some close covering.

In towns, large quantities of potatoes for sale are too commonly seen exposed to the injurious effects of light; and in London, more formerly than at present, washed potatoes are so exposed by many of the retail dealers. Now, a few days' exposure will have the effect of tinging the flesh of unwashed potatoes; but when their surface is washed, and thus deprived of the partial shade which the particles of soil afford, the action of light will be still more injurious. The purchasers, who suffer by the practice more than the generality of them are aware, have the power of remedying the evil; for the vendors would not take the trouble to wash the tubers if they found the unwashed preferred, neither would they expose the potatoes much to the light, if their customers objected to the practice. From what has been stated, it will be understood that potatoes should be stored so as to be in the dark. The next consideration is, how to protect them best from frost, and at the same time to preserve them from being contaminated by gases arising from fermentation and from rotting. In choosing materials for protecting from frost, care should be taken to avoid using such as will, on contact, taint the flavour of the potatoes. It has been ascertained that

potatoes keep best in small quantities; for, when in large heaps, they sometimes ferment. The form of a ridge is more convenient than that of a cone, because, when portions are taken out for use, the breach in the end of the ridge can be more easily closed than one in the side of a conical heap. The ridges should run in the direction of north and south, so that if it be necessary to open them in frosty weather, that may be done at the south end, when the sun's rays at noon will prevent that part from being frozen. The ridge may be about 3 feet, or not more than 4 feet wide at the base, and as high as the potatoes can be conveniently piled up. The ridges should not be formed on wet heavy ground; that which is poor, dry, and on a slope is to be preferred. In throwing up the soil for covering, a trench will be formed round the base of the ridge, and this trench should be made deepest at one end, from which a track should be cut, so that water may not collect in the trench, which ought, in all cases, to be lower than the base of the ridge. In dry soil the latter may be sunk a few inches, but if otherwise the potatoes should be laid quite on the surface of the ground. As already observed, soil is best next the tubers, and the poorer it is the better. Straw admits of the potatoes being taken out comparatively free from earth, but as it decays from contact with the soil, it injuriously affects their flavour. Dry turf may be laid next the potatoes to prevent loose soil from mixing with them, or fresh turf, laid with its green side outwards, may be used for the same purpose; but as regards the flavour of the potatoes these appliances are unnecessary, if not worse than useless. The spaces between the tubers are, of course, filled with air, and if much decay take place the whole of the potatoes will be in contact with a contaminated atmosphere; but if the interstices are filled with soil, the gases arising from a decaying tuber will be in a great measure absorbed by the surrounding earth. After covering with 8 or 9 inches thick of soil, it is a good plan to thatch the ridges with straw, fern, heath, or any other material calculated to keep out frost and wet. Potatoes intended to be kept till the following summer should be placed in a shaded situation where the sun's rays cannot affect the ridges. If the soil of these should happen to be frozen in spring to the depth of a few inches, then by covering thickly with straw the potatoes may

be kept from pushing much longer than would otherwise be the case.

To save Seed.—The ripest potato apples should be selected and exposed to the sun's rays till they begin to shrivel. They should afterwards be thrown into water, and remain in it till they again become plump. The seeds can then be easily squeezed out, washed, and laid on a paper to dry.

Insects and Diseases.—"Potatoes are assailed by a host of insects, but in a healthy state the wireworms are the most injurious. *Aphis rapæ* is found on the potato as well as the turnip. *Thrips minutissima* and *Smynturus solani* also live beneath the leaves, and the plant-bugs, *Lygus solani*, *contaminatus*, *bipunctatus*, and *umbellatarum*, pierce the leaves and imbibe the sap, as well as the frog-flies, *Eupteryx solani* and *picta*. *Altica exoleta* riddles the leaves, and the caterpillars of *Sphinx atropos* live upon them. Those of *Agrotis segetum* and *exclamationis*, called surface-grubs, and the maggots of crane-flies, *Tipula oleracea*, *paludosa*, and *maculosa*, infest the roots, together with the wireworms of *Agriotes lineatus*, *obscurus*, and *sputator*, as well as snake millipedes, *Julus Londinensis*, *terrestris*, *pulchellus*, and *Polydesmus complanatus*, with centipedes and scolopendræ, named *Lithobius forcipatus*, and *Geophilus longicornis* or *electricus*; whilst the destruction of the rotting tubers is accelerated by multitudes of the maggots of flies, rove-beetles, worms, and acari."—(Curtis, in *Morton's Cyclopedia of Agriculture*.)

Potatoes are sometimes attacked by a disease called the *curl*, which towards the close of the eighteenth century excited considerable alarm, particularly in the northern parts of the kingdom, but has now nearly disappeared. In this disease the shoots become curled when young, and their growth is arrested; the leaves are curled and crumpled, and no tubers, or only small and worthless ones are produced. Various conjectures have been formed as to the cause of the disease, but the most probable is that it arises from an excessive supply of nourishment; and this view seems to be confirmed by the circumstance that potatoes

from imperfectly ripened sets, or from sets raised in poor ground, are not so liable to be attacked as those grown in rich soil, and originating from well-matured tubers.

The *scab* is a disease in which ulcers are formed upon the surface of the tubers. Though not very destructive it is very prevalent, most crops being more or less affected. The cause of its appearance has not been satisfactorily determined, but the disease is said to be brought on by coal ashes, lime rubbish, or dung being added in excessive quantities to the soil, or not properly mixed with it. But the most fatal disease by which the potato is attacked is that known as the *potato murrain*, or potato disease, which broke out with such fearful violence in 1845. It appears to be caused by a fungus, called *Botrytis infestans*

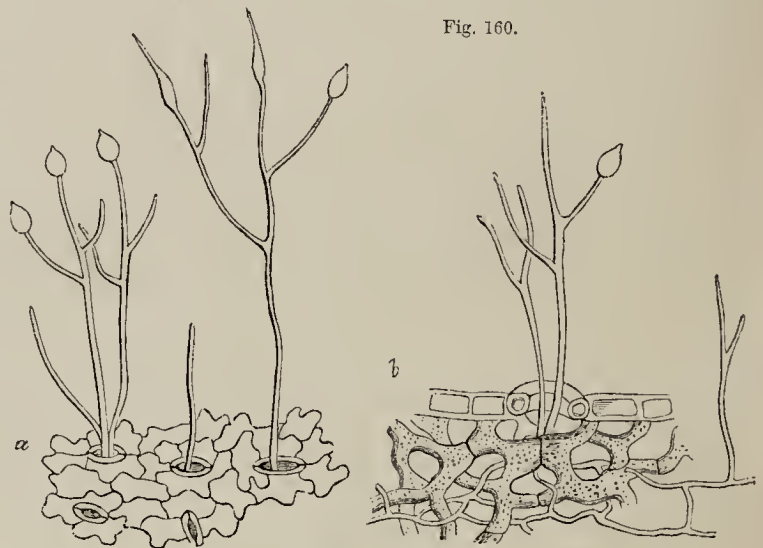


Fig. 160.

BOTRYTIS INFESTANS.

a, Young plants, with spores proceeding from stomata. *b*, Section of potato leaf, showing the mode in which the mycelium creeps amongst the loose tissue of the leaf.

(Fig. 160), which first attacks the haulm, and afterwards descends to the tubers, which soon become a mass of putridity. Though numerous experiments have been made with a view to discover a remedy, all have terminated unsuccessfully, and no effectual means either of prevention or cure are known. Happily this disease is diminishing in intensity, and it is probable that in a few years it will have become a matter of history.

PURSLANE (*Portulaca oleracea*, L.—*Dodecandria Monogynia*, L.; *Portulacæ*, D. C.; *Portulacæ*, Lind.) is an annual plant, a native of South America and of both Indies. The leaves and young shoots possess cooling and antiscorbutic properties, and when young

are used in salads; when rather older they are employed as a pot-herb; they are also sometimes pickled with vinegar.

There are three sorts:—

1. COMMON, OR GREEN PURSLANE.
2. GOLDEN PURSLANE.
3. LARGE-LEAVED GOLDEN PURSLANE (*Pourpier doré à très large feuille*).

The second sort is more esteemed than the common. The third is a new and improved French variety.

Purslane requires a light rich soil and a warm situation. It should be sown in shallow drills 9 inches apart, or thinly broadcast, and very lightly covered with earth. As this plant is cut off even by a slight frost, it cannot be sown out of doors until the middle of April or beginning of May, according to the state of the weather. Prior to this time, it is sown under glass, if an early supply is required. The first sowing may be made on a south border at the above period, and a small quantity may be sown for succession in May, June, July, and August; after which time it ceases to be required. Both the seed-bed and plants should be frequently watered through a fine rose. This greatly contributes to the succulence of the shoots and leaves, and encourages their speedy reproduction after cutting. Seed should be saved from the most vigorous plants of the first sowing; and, as soon as the capsules begin to open, the plants should be carefully cut over, and spread upon a cloth in the sun, fully to ripen their seeds, which can afterwards be easily separated from the seed-vessels by rubbing with the hands and sifting.

QUINOA (*Chenopodium Quinoa*, Willd. — *Pentandria Digynia*, L.; *Chenopodæ*, D. C.; *Chenopodiaceæ*, Lind.)—The quinoa (Fig. 161) is an annual plant, growing from 4 to 6 feet high, a native of Peru. In the high tablelands of the Cordilleras it was, at the time of the conquest by the Spaniards, almost the only farinaceous seed used as food; and it still forms, together with the potato, the common food of the poorer inhabitants of those regions. The seeds are used in soups or made into a sort of bread, and are said to be easy of digestion, and in no way prejudicial to the health. By fermenting them together with millet, a sort of beer is made. They also constitute an excellent food for poultry; and the leaves gathered when tender form a very good substitute for spinach in summer. The last

two purposes are the only ones for which this plant is likely to be cultivated in Britain, for

Fig. 161.



the seeds possess a peculiar bitterness to which few persons can be reconciled. Upon this subject M. Vilmorin makes the following remarks in the *Bon Jardinier*:—"The plant is very vigorous, almost insensible to cold; it produces, when grown on good soil, seeds in great abundance, but these have never as yet been found capable of being used in a satisfactory manner. Whether it is that the seed does not acquire in France the same qualities that it does in America, or, what is more likely, that we are not accustomed to its taste, few persons relish it. It has the great drawback of being distinctly acrid and bitter, and this taste can only be removed by repeated washings. By the aid of these very good cakes and tolerable soup have been made at my

house, but their preparation was very troublesome, on account of the bitterness, which had to be removed, and the long baking or boiling which they required."

There are several varieties of the quinoa; some having green, or variously-coloured leaves, and black, red, or white seeds; the last is the one grown for seeds to be used as food.

It requires a rich soil, rather light than otherwise, and a warm situation to ripen the seeds. It may either be sown on a gentle hot-bed in March, for planting out in April or May; or out of doors in April, in drills 2 feet asunder. When the plants are 4 or 5 inches high, they may be thinned out to 18 inches apart in the rows, and the thinnings may be planted in rows at the same distances apart. In dry weather water should be given; and if the plants are grown for spinach, the stems should be topped at the first gathering, to induce them to branch. The leaves may be gathered in succession throughout the summer. The seeds ripen in September.

RADISH (*Raphanus sativus*, L.—Tetradynamia Siliquosa, L.; Cruciferae, D. C.; Brassicaceae, Lind.)—The radish is an annual plant, a native of China, and was grown in this country before 1548. It is chiefly cultivated for the roots; but the seed-pods, pulled when green, are occasionally pickled, and the seed-leaves are sometimes used as a small salad.

The principal varieties may be classed as follows:—

§ 1. *Long-rooted Spring and Summer Radishes.*

1. **LONG SCARLET**—syn. Salmon Radish, Transparent Radish, Rave rose, Rave couleur de rose, Rave saumonée.—Roots long, a considerable portion growing above ground; outside of a deep pink colour. Flesh white, transparent, crisp, and of good flavour. It is much cultivated for the London market, and is greatly esteemed for its bright colour. There are several sub-varieties of this, differing in size and earliness, and distinguished as the Scarlet Short-top, Early Frame Scarlet, and Wood's Early Frame.

2. **PURPLE**—syn. Rave rouge longue, Rave de corail.—Root long, a large portion growing above ground; outside deep purple, flesh white, and of good flavour. The seed-leaves, which are large, are used as a small salad. An early sort, good for forcing.

3. **LONG WHITE**—syn. White Transparent, White Italian, Naples Radish, Rave blanche of the French.—Root long, small; outside white, except where exposed to the light, when it is tinged with green. Flesh white and mild.

§ 2. *Turnip-rooted Spring and Summer Radishes.*

4. **SCARLET TURNIP-ROOTED**—syn. Crimson Turnip-rooted, Radis rouge, Radis rose rond.—Bulb turbinate; outside deep scarlet. Flesh white, sometimes stained with red, and of mild flavour. An excellent variety, much cultivated for the London market. The Early Scarlet Turnip-rooted, or Radis rose rond hâtif, the flesh of which is rose-coloured, appears to be a sub-variety. It is cultivated for the Paris markets.

5. **PURPLE TURNIP-ROOTED**—syn. Radis violet rond.—Resembles the preceding in form, size, and flavour; only the outside is purple.

6. **OBLONG ROSE-COLOURED**—Radis rose demi-long of the French.—Root oblong, or somewhat oval; outside bright crimson; flesh tender, rose-coloured, and excellent. In point of quality it is admitted to exceed all others. It is early, well adapted for forcing, and for the general crops.

7. **WHITE TURNIP-ROOTED**—syn. Radis blanc rond, Radis blanc ordinaire.—Bulb round, terminating in a small fibrous root; outside white. Flesh white, transparent, and of mild flavour.

8. **EARLY WHITE TURNIP-ROOTED**—syn. Radis blanc hâtif, Radis blanc hâtif de Hollande.—Bulb resembling the preceding in form and colour, only of smaller size. An early and excellent variety, very generally cultivated.

§ 3. *Autumn Radishes.*

9. **LONG-LEAVED WHITE CHINESE**—Radis blanc de Chine à feuille longue of the French.—Bulb inversely turbinate; the outside white. Flesh tender, excellent, and milder in flavour than that of the Spanish radishes. The leaves are long, nearly entire, and very unlike those of the other varieties. An excellent autumn sort.

10. **ROSE-COLOURED CHINESE**—Radis d'hiver de Chine of the French.—Bulb somewhat conical, of a bright rose-colour. Flesh solid,

of fine texture, and rather hot. An excellent autumn variety.

§ 4. *Winter Radishes.*

11. **BLACK SPANISH**—*Radis noir d'hiver*, Raifort of the French.—Bulb of large size, oval, or pear-shaped, terminating in a long slender tap-root; outside rough and black. Flesh white, hard, and hot. The Purple Spanish, or Large Purple Winter Radish, is a sub-variety of this.

12. **WHITE SPANISH**—*Radis gros blanc d'Augsbourg* of the French.—Bulb oval, attaining a large size; outside white, tinged with green. Flesh white, solid, and hot; milder, however, than that of the preceding.

The radish will succeed well in any good garden soil, not over moist, or too heavy. For early and late crops a warm, sheltered situation should be chosen; whilst for those sown in the heat of summer a rather shady spot must be selected. The ground where the sowing is to be made should be deeply dug, and raked fine. The seed is generally sown thinly broadcast, in beds from 4 to 5 feet wide, with 1-foot alleys between, the soil from the latter being used to cover the seeds, but only lightly. The surface is then raked smooth, and in light soils pressed with the back of the spade. Winter radishes, however, are best sown in drills 6 inches asunder; but if roots of large size are desired, as much as 9 inches may be allowed. After sowing, the beds should be netted over to protect from birds, which are very fond of the seeds.

Where radishes are not forced, a sowing may be made in the middle of December, if the weather is mild; and immediately after having been sown the seed-beds should be covered with about 4 inches thick of litter, which should not be removed till the plants come up, and then only in the day-time when the temperature is above 32°. The crop, if not destroyed by frost, will be fit for use about the beginning of March; but this greatly depends upon the weather.

A sowing, to be treated in a similar manner, may be made in the course of January, weather permitting; and another may take place in the first fortnight in February. With the Parisian market gardeners this is the first crop of radishes they raise out of doors. For this sowing they form a sort of hot-bed, by digging a trench 18 or 20 inches deep, and filling it

up with from 14 to 16 inches of dung, which is covered with 4 inches thick of vegetable mould. On this the seed is sown; and if the weather is frosty at night the bed is protected with straw mats. Another sowing, also in a warm situation, may be made in the second fortnight of February, and from that time till the middle of October, a small quantity may be sown, in any open situation, every fortnight in spring, and every ten days in the heat of summer.

Lastly, in the end of October, and again in the middle of November, a small sowing may be made on a south border, or on a sloping bank. The plants from these sowings must be protected in severe weather with litter, or straw-mats, which should be removed at every favourable opportunity. After sowing, with the exception of thinning out the plants where too close to about 3 inches apart, weeding, and frequent watering, no further attention is necessary.

The winter radishes may be sown in the beginning of July, and again in August, in shallow drills from 6 to 9 inches asunder, and the plants where too close may be thinned out or drawn for use in a young state, so as to leave those which are intended to attain a large size at 5 or 6 inches from each other in the row. The roots are fit for use towards the end of autumn. Those required for winter consumption should be taken up in November or December, before severe frost sets in, and stored in dry sand like carrots.

To save Seed.—Only the finest plants, true to their variety, should be selected from one of the spring sowings for producing seed. The plants should be taken up in April or May, and planted 2 feet apart in well-dug ground, water being given at planting, and subsequently till they take fresh root. The seed ripens in September, and must be gathered successively as it comes to maturity. It should then be dried in the sun, rubbed out of the pods, and stored. It keeps good for four or five years. Seed of the winter radishes is saved from full-grown roots, transplanted in March.

RAMPION, *The* (*Campanula Rapunculus*, L. —*Pentandria Monogynia*, L.; *Campanulaceæ*, D. C.; *Campanulacæ*, Lind.)—is a biennial plant, a native of Britain. It is cultivated for its fusiform, white, and fleshy root, which is generally eaten raw, but sometimes in a boiled state in salads; the leaves as well as the roots are occasionally used in winter salads.

It prefers a rich, free, and rather light soil; and a shady situation. It is raised from seed, which may be sown any time between March and July; but if sown earlier than the end of May the plants are apt to run to flower the same year, and when this is the case, the roots become tough and unfit for use. The ground should be well dug, and raked as fine as possible; the seed may then be sown either broadcast, or in drills 6 inches apart, and about $\frac{1}{4}$ inch deep, formed by pressing the angle of a measuring rod upon the ground. As the seeds are very small it is advisable to mix them with fifteen or twenty times their bulk of fine sand, in order to insure their even distribution in the drills, and to prevent the plants from coming up too closely. The seed should only be very slightly covered with fine earth, and the seed-bed ought to be frequently watered with a fine-rosed watering-pot till the plants come up, which will be in about a fortnight. When the young plants are about 1 inch high they should be thinned out to about 4 inches apart; after this no further care is necessary than to water frequently, and to keep the ground free of weeds. Small sowings may be made in the end of June and July, in case the plants from the May sowing should run.

The roots will be fit for use from November till April or May; and they may either be pulled up as wanted, or taken up at once and stored in sand. The plants send up flower-stalks about 2 feet high, which bear small blue or white flowers in July and August. The seeds ripen in autumn.

RAPE (*Brassica Napus* var. *oleifera*, D. C.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.) is a biennial plant, a native of Britain. It is only grown in gardens as a small salad; it is sown at the same times, and treated in exactly the same manner, as mustard and cress.

RHUBARB (*Rheum*, L.—*Enneandria Trigynia*, L.; *Polygonaceae*, D. C.; *Polygonaceae*, Lind.) is cultivated for the leaf-stalks, which, both in a natural and blanched state, form an excellent substitute for fruit in tarts and pies. They likewise make a delicious preserve. A wine is also obtained from them, but it is very unwholesome. For these purposes several species and varieties of *Rheum* are cultivated. Amongst the best are the following:—

TOBOLSK RHUBARB.—Early, and good for forcing. The **ELFORD**, raised by Mr. W. Buck, of Elford, Staffordshire, an early sort, well adapted

for forcing. The stalks are rather slender, covered with a thin skin of a bright scarlet colour, and their substance throughout is of a fine red, which they retain when cooked, if not peeled, a process which, owing to the thinness of the skin, is not considered necessary. Even when grown in the dark, the stalks still preserve the crimson tinge. **MITCHELL'S ROYAL ALBERT**.—Very early and prolific; stalks large, red, and of excellent flavour. **RANDALL'S EARLY PROLIFIC**.—An abundant bearer; the stalks are produced early in the season, and are of excellent quality. **MYATT'S LINNÆUS**.—A very good early sort, of fine quality. **MYATT'S VICTORIA**.—About a fortnight later than the preceding; stalks very large and thick; of good quality.

The leaf-stalks of *RHEUM AUSTRALE*, Don. (*Rheum Emodi*, Wallich), attain an immense size, but are unfit for use in consequence of their strongly purgative properties; but the leaves, which are frequently a yard in diameter, are very useful for covering baskets containing vegetables or fruit, and it is only on this account that the species is mentioned here. It requires to be planted 4 feet apart, in rows 6 feet asunder.

Rhubarb succeeds best in a rich deep soil, rather light than otherwise, and in a situation well exposed to light. It may be raised from seed sown in spring, but the mode of propagation generally adopted is by dividing the roots, a bud, of which there are several on the crown, being preserved to each piece.

The ground having been deeply trenched, and well manured with rotten dung, the divisions of the roots may be planted with the bud about 2 inches below the surface, 3 feet apart, in rows from 3 to 4 feet asunder, according to the variety planted, and the quantity of ground at disposal. The plantation should be made as early in spring as the weather and state of the ground will permit. After planting, with the exception of keeping the ground clean, stirring the surface occasionally, and digging or forking it over early in spring, no further culture is required. No leaves should be removed the first year, but in the following spring an ample supply may be obtained. In gathering for use, the leaf-stalks should be bent down, and pulled, not cut off. The flower-stems, if seed is not required, should be cut off soon after they make their appearance. In other respects, the culture in this, and every succeeding year, is the same as before. Some

well-decomposed dung may, however, be dug in when the ground is stirred. Plantations will continue in good production for several years; but it is advisable to make a new one every fourth or fifth year, otherwise the produce is inferior in size and quality to that obtained from ground more recently planted. Some sorts of rhubarb will, however, continue in good bearing for twelve years, and even longer when properly supplied with manure.

Rhubarb is sometimes blanched; this may be partially effected without removing the plants, by means of sea-kale pots, or earthenware cylinders left uncovered at top, or more perfectly by taking up the roots and placing them in some dark place with a temperature of 55° or 60°, where they should be slightly covered with soil to prevent them from drying.

ROCAMBOLE (*Allium Scorodoprasum*, L.—Hexandria Monogynia, L.; Siliaceæ, D. C.; Siliaceæ, Lind.) is a hardy perennial, a native of Denmark. It is cultivated for its bulbs, which are smaller and milder than those of garlic, and are used for the same purposes. The bulbs are chiefly produced at the roots, and consist of several cloves; but the stem, which rises to the height of about 2 feet, also produces a cluster of small bulbs. It may be propagated either by separating the cloves of the radical bulbs, or by planting those produced on the stem. The former mode is the preferable one, and that generally adopted; for plants raised by the second method do not yield bulbs fit for use till the second year. The cloves should be planted, in well-dug ground, in the end of February, or in March; or after the leaves have died down in autumn. They ought to be planted 2 inches deep, in rows 8 inches apart, and 6 inches asunder in the row. All the culture necessary is to keep the ground clean. When the leaves begin to decay, the bulbs should be taken up, dried in the sun, and stored for use. Some may also be drawn for use before they have attained complete maturity.

ROSEMARY (*Rosmarinus officinalis*, L.—Diandria Monogynia, L.; Labiatae, D. C.; Lamiales, Lind.) is a hardy evergreen under-shrub, a native of the south of Europe. Though not employed in cookery, this plant is grown in every kitchen garden. A decoction of the foliage is employed to relieve headaches, and is very efficacious in promoting the growth of the hair, and in curing baldness. It is likewise used in the manufacture of Hun-

gary water, and eau de Cologne. The sprigs are sometimes used as a garnish.

Three varieties are cultivated:—

1. COMMON, OR GREEN-LEAVED ROSEMARY.
2. SILVER-STRIPED ROSEMARY.
3. GOLD-STRIPED ROSEMARY.

The last two varieties, being rather more tender than the common sort, require protection in winter; they are chiefly cultivated for ornament.

Rosemary requires a light dry soil, and a warm sheltered situation. It is propagated by cuttings or rooted slips, taken off in April or May, or by layers. The rooted slips may be planted at once where they are to remain. The cuttings, which ought to be 5 or 6 inches in length, should first be planted 3 or 4 inches deep in a rather shady situation, where they may remain till the beginning of September, by which time they will have taken good root. They may then, or in the following spring, be finally planted 2 feet apart. Cuttings may also be struck in gentle heat, with greater expedition. The second and third sorts should be planted under the shelter of a wall or paling, and protected in frosty weather with mats, otherwise they are liable to be killed. All the culture required is to trim the plants occasionally, to keep the ground free of weeds, and to stir it occasionally.

RUE (*Ruta graveolens*, L.—Decandria Monogynia, L.; Rutaceæ, D. C.; Rutaceæ, Lind.) is an evergreen under-shrub, a native of the south of Europe. The leaves have a nauseous smell, and a hot, bitter taste. They are sometimes employed as a garnish, and are administered to poultry affected with the croup. It is still much used in popular medicine, being considered to be emmenagogic, antispasmodic, stimulant, and sudorific, and its efficacy as an anthelmintic is unquestionable; but danger attends its incautious use.

This plant grows well in any soil, but is not so liable to be injured by frost in poor, dry soil, as in a rich garden mould. It may be propagated in March or April by seeds, cuttings, and slips; the last is the method generally adopted. The seed may be sown broadcast, and raked in; and when the young plants are 3 or 4 inches high they may be planted out where they are to remain. The cuttings, or slips, should be put in deeply in a shady border till they have taken root, after which they may be planted out in rows 18 inches apart, and 8 inches asunder in the row. All

the plants will require is an occasional trimming. It is also advantageous to cut down a portion of the plantation every third year, to cause a production of young shoots.

SAGE (*Salvia officinalis*, L.—Diandria Monogynia, L.; Labiatae, D. C.; Lamiaceae, Lind.) is a hardy evergreen under-shrub, a native of the south of Europe. The leaves are much used in stuffings and sauces, and were formerly in great demand for sage-tea.

The varieties cultivated are:—

1. COMMON, OR RED SAGE.
2. GREEN SAGE.
3. NARROW-LEAVED GREEN SAGE, OR SAGE OF VIRTUE.

4. BROAD-LEAVED GREEN, OR BALSAMIC SAGE.

The first and second sorts are those most esteemed for culinary purposes, the Red sage being generally preferred; the others are used for medicinal purposes.

It grows well in most soils and situations, but succeeds best in a light, warm, and rather dry soil. It may be raised from seed sown on a gentle hot-bed in spring; and when the young plants are well-rooted, they should be hardened off, taken up with balls, and planted 1 foot apart, in rows 18 inches asunder. Sage is, however, seldom raised from seed, being generally propagated by cuttings or slips of the young shoots taken off in April, May, or June. The lower leaves should be cut off, the cuttings inserted in a shady border, and a hand-glass placed over them; or they may be planted at once in any vacant frame. Water must be given at planting if the soil is not sufficiently moist, and occasionally till they strike. After this, harden off, and, when well-rooted, plant out at the distances previously indicated. It is a good practice to pinch off the extremities of the shoots, to prevent the plants from flowering, and to induce them to throw out laterals, and become compact bushes. The plants require an occasional trimming to make them grow close and bushy. The ground should be kept free of weeds and stirred in spring and autumn. Sage will continue a long time in the same place; but as the plants become naked and straggling with age, a fresh plantation ought to be made every three or four years, if necessary. In gathering, the young side and top shoots should be taken; and a quantity of these should be cut before coming into flower, and dried for winter use.

SALSIFY (*Tragopogon porrifolius*, L.—Syn- genesia Polygamia Æqualis, L.; Compositae,

D. C.; Asteraceae, Lind.) is a hardy biennial plant, a native of England. It is cultivated for its long, tapering, fleshy root, which is white both outside and inside, larger than that of scorzonera, and not so liable to fork. The roots are scraped, cut into pieces, and steeped for a while in vinegar; they are then boiled in water like parsnips, and served up with melted butter, white sauce, and in various other ways. They are also fried in butter after boiling, and served with parsley. The stalks are sometimes cut when 4 or 5 inches long, and dressed as asparagus, and in this way they are said to be excellent.

It requires a free rich soil which has not been newly manured, and an open situation. The ground where it is to be grown should be trenched 2 feet deep in the end of autumn, or at least dug two spades deep, in order that the long roots may freely strike downwards.

It is raised from seed, which should be sown on the ground trenched in autumn, and further prepared by digging previous to sowing, in drills 1 inch deep, and 1 foot apart. A first crop may be sown in March, the main one towards the end of April, and small sowings may be made towards the end of May to come in a little later, and to supply the place of the others, in case the plants of the former sowings should run to seed the same year. In dry weather the seed-beds should be copiously watered to induce germination. When the young plants are 2 or 3 inches high, they may be thinned out to 8 inches apart in the row. The ground should be hoed occasionally and kept free of weeds. In October and November, roots may be drawn for use; and at the approach of frost, some may be taken up and stored in sand, for a supply during its continuance. The roots left in the ground will be fit for use throughout the spring till they run to seed, when they become tough, woody, and useless. The flowers appear in May and June, and seed is ripened in autumn.

SAMPHIRE (*Crithmum maritimum*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceae, Lind.) is a hardy perennial, a native of Britain, growing naturally on rocks near the sea. The stem rises to the height of about 1 foot or rather more; the leaves are lanceolate and fleshy; the flowers, which are yellow, appear from July to September. The leaves pickled in vinegar are used in salads, and as a seasoning. It is rather difficult to cultivate in gardens, and the produce is never so good

as that obtained from the places where it naturally grows. It may either be propagated by dividing the plant, or by sowing the seed in April, or in autumn soon after it is ripe; the latter period is preferable, for if kept till spring the seed does not germinate so well. It succeeds best in a light sandy or gravelly soil, kept constantly moist, and sprinkled occasionally with a little sea-salt, or barilla, or watered with a solution of these substances in order to supply the plant with soda, which is a necessary element of its food. It will grow still better if planted or sown among stones at the foot of walls, with a south or east aspect; this, and an occasional watering with a solution of sea-salt, will give conditions nearly the same as those under which the plants naturally grow. As it is rather delicate and liable to be injured by frost, it should be protected with dry litter or leaves during the winter. Towards the end of summer, leaves may be cut for pickling. The seeds resemble those of fennel, but are larger; they ripen in autumn, and do not usually germinate after the following spring is past.

SAMPHIRE, GOLDEN (*Inula crithmifolia*, L. — Syngenesia Polygamia Superflua, L.; Compositæ, D. C.; Asteraceæ, Lind.)—The golden samphire is a hardy perennial, a native of England, where it is found growing in salt marshes. The leaves are fleshy and succulent, and the young branches are sometimes sold for the true samphire, to which they are much inferior. They are used in the same way. It will grow if planted in a shady border and watered frequently; if salt be occasionally dissolved in the water, the plant will thrive so much the better.

SAVORY (*Satureja*, L. — Didynamia Gymnospermia, L.; Labiata, D. C.; Lamiaecæ, Lind.)—The aromatic tops of savory are put into salads and soups; they are also boiled along with pease and beans.

Two species are cultivated — **SUMMER SAVORY** and **WINTER SAVORY**.

SUMMER SAVORY (*Satureja hortensis*, L.) is a hardy annual, a native of Italy and the south of France. It is raised from seed, which should be sown on a warm border in April, in shallow drills 1 foot apart, thinning out the young plants when 2 or 3 inches high, to 6 inches asunder in the rows; the thinnings may be planted at the above distances, and watered at planting, and till they take fresh root. When just coming into flower, a quantity

should be pulled up, dried in the shade, and tied up in packets for winter use.

WINTER SAVORY (*Satureja montana*, L.) is a hardy evergreen under-shrub, a native of the south of France and Italy. It may be raised from seed sown in April; but is generally propagated by dividing the plant in March or April, or by cuttings of the young shoots taken off in April and May. The cuttings should be planted on a shady border, and watered till they take root. When well-established, they may be planted out 1 foot apart, in rows 15 inches asunder. Some may also be planted as an edging. The plants should be trimmed every year in autumn, and the ground between the rows ought to be occasionally stirred; but in doing this care must be taken not to injure the roots. Fresh plantations should be made before the plants grow old, and cease to produce a sufficient supply of leaves.

SAVOY (*Brassica oleracea bullata major*, D. C. — *Tetradynamia Siliquosa*, L.; Cruciferae, D. C.; Brassicaceæ, Lind.)—The Savoy differs from other cabbages in having blistered leaves, which form one large head, instead of several, as in the case of the Brussels sprouts, the small heads of which are merely miniature Savoy.

The principal sorts are:—

1. **EARLY ULM**—syn. Early Green Curled, New Early, Chou de Milan très hâtif d'Ulm.—Head small, round; outer leaves rather plain, forming a sort of cup, with the edges rolled a little outwards, of a deep green colour. It heads very quickly, is of excellent quality, and the earliest sort known. It may be planted much closer together than the larger kinds, in good soil 15 inches apart, and in poor ground 15 inches by 12 will be sufficient.

2. **MARCELIN**.—A new sort allied to the Early Ulm, but growing somewhat larger. Though not so early, it is next to it in point of earliness, and if both sorts are sown at the same time, the Marcelin will form a succession. It is dwarf; the leaves dark green, finely wrinkled and curled. The head is round, compact, and of excellent quality. When cut above the lower course of leaves, about four small heads, almost equal in delicacy to Brussels sprouts, are generally formed. This sort is exceedingly hardy, and, on the whole, it must be considered a valuable acquisition. It may be planted 18 inches by 12 inches apart.

3. **EARLY DWARF GREEN CURLED**—syn. Dwarf, Dwarf Green, Milan hâtif.—Similar in quality to the preceding, but dwarfer.

4. **EARLY FLAT GREEN CURLED**—syn. Chou de Milan court, nain, or trapû.—Middle-sized, very dwarf and flat-headed; deep green, tender, and very good.

5. **DWARF GREEN CURLED**—syn. Small Dwarf Green Curled, Pancalier de Tourraine.—Stem dwarf; leaves deep green, very rugose, much curled at the margin; hearts well, and is very good, especially when mellowed by the first frosts in autumn. It is hardier than the preceding sorts, and forms a succession to them.

6. **LARGE LATE GREEN CURLED**—syn. Large Green, Late Green, Large Late Green, Globe, Milan ordinaire, Gros Chou de Milan.—Larger than the preceding, and lighter green; very rugose and hardy.

7. **LARGE GREEN GERMAN**—syn. Drumhead, Cape, Large Late Green, Milan des Vertus, Gros Chou pommé-frisé d'Allemagne.—This is the largest kind of Savoy, and the best among the large. The leaves are plainer than in the other varieties; the head roundish, a little flattened, like a Drumhead cabbage, which it also approaches in size. It is hardy, withstanding the frosts of ordinary winters very well.

8. **CONICAL**—syn. Milan à tête longue.—Rather small, pointed, green, hardy, of very good quality, but affording a less weight of produce than several of the preceding sorts.

9. **EARLY YELLOW**—syn. Yellow Globe.—Middle-sized, roundish, yellow; hearts early, of tender substance when cooked, and very good, but some object to the colour.

10. **EARLY LONG YELLOW**, or Milan doré à tête longue.—This also is an early variety, but it does not heart firmly.

11. **YELLOW CURLED**—syn. Yellow, Large Late Yellow, White Savoy, Blœmendale, New Blœmendalers, Milan doré or de Savoie.—Dwarf, middle-sized, round; leaves pale green at first, but quite yellow in winter. The heart is not so compact as some, but it is of tender quality, and by many it is preferred, being considered much sweeter than the other kinds. It is later and hardier than the other yellow Savoys.

The Savoy succeeds best in a moderately rich soil, neither very stiff nor too highly manured, and in an open situation. For a supply in the end of autumn, and throughout the winter, three sowings will generally be sufficient; namely, one towards the close of February for an early crop, another about the

middle of March, and a third in the middle of April for late productions. In early soils the third weeks of March and April will be soon enough. Sometimes, also, a small quantity is sown in the beginning of August, to come in for use early in autumn; but sowing some early sort, such as the Early Ulm, in spring is preferable.

The ground for the seed-bed having been prepared, the seed is sown thinly broadcast, and raked in, and in light soils the surface is pressed with the back of the spade. When the young plants have made two or three rough leaves, they should be pricked out 3 inches apart into nursery beds. In May some of the most forward plants of the early sowing may be planted out for use in September, if this vegetable is required so early; the remainder may be transplanted in the course of the month of June. The main crop and latest sowing may be planted out in July and August, when rain is likely to fall. In all cases the strongest plants of the respective sowings should be planted out. On taking up the plants, their roots should be examined, in order to ascertain whether they are clubbed or not, and all that exhibit any signs of that disease should be rejected. The distances at which the plants may be put in, varies with the sort, and nature of the soil; in poor ground, less space being required than in rich soil. Small kinds, like the Early Ulm, may be planted 12 inches apart, in rows 15 inches asunder, whilst for the Large Green, and similar sorts, the distance should be increased to 2 feet each way; sorts of medium growth may have the above distance between the rows, whilst 18 inches may be allowed between the plants in the rows. After planting, if the weather be dry, the plants should be watered, and this ought to be continued till they are again established; afterwards all the culture required is confined to hoeing the ground occasionally.

Except in very severe winters, Savoys do not require protection from frost; sometimes, however, the plants are inclined towards the north, and the earth taken from that side placed over the roots on the opposite side. The late crop remains fit for use till the end of February or later.

Seed is saved in the same way as practised with the cabbage; it ripens in the months of July and August.

SCORZONERA (*Scorzonera hispanica*, L. — Syngenesia Polygamia Æqualis, L.; Composi-

tæ, D. C.; Asteraceæ, Lind.) is a hardy perennial, a native of Spain. The root, for which the plant is cultivated, is tapering and shaped like that of a carrot; its skin is black; the flesh on the inside white. The roots are cooked in the same way as those of salsafy.

It succeeds best in a light, deep, free soil, and an open situation; and the ground for its reception should be trenched. It is raised from seed, which may be sown in drills 1 foot apart, covering the seed with soil to the depth of $\frac{1}{2}$ inch. As it is apt to run to seed the same year in which it is sown, and consequently to become tough and woody, it is better not to sow the general crop till the end of April, in the hotter part of the kingdom; elsewhere it may be sown in the end of March, or from that time to the middle of April. A second sowing may be made in May, as a precautionary measure, in case the plants of the first sowing should run. The young plants, when 3 or 4 inches high, should be thinned out to 8 inches asunder in the rows. In September, some of the roots will have attained sufficient size to be drawn for immediate use; others will come in for use in October and November. In the latter month they will be in perfection, and before frost sets in, a quantity may be taken up and stored in sand for a supply during its continuance. At other times, the roots remaining in the ground will afford a supply throughout the winter and spring; and will continue fit for use till April or May, about which time the plants begin to run to flower. Before this takes place any roots remaining in the ground should be taken up and placed in sand. The seed ripens in autumn, and is best when saved from plants two years old.

SCURVY GRASS (*Cochlearia officinalis*, L.—*Tetradynamia Siliculosa*, L.; Cruciferae, D. C.; Brassicaceæ, Lind.) is a hardy annual, a native of Britain, found growing on the seashores, among sand and stones. It grows from 6 to 12 inches high, has shining, roundish, heart-shaped leaves, and small white flowers, which appear in tufts among the branches in May. In a fresh state it is stimulant, diuretic, and a powerful antiscorbutic, on account of which qualities it is still cultivated in some gardens for use in salads. It is raised from seed, which is sown broadcast in April on a moist soil, and in a shady situation. When the young plants are about 2 inches high, they should be thinned out, if too close, to about 4 inches apart, after which they require no

further culture than to keep them free of weeds, and to water frequently in dry weather.

SEA-KALE (*Crambe maritima*, L.—*Tetradynamia Siliculosa*, L.; Cruciferae, D. C.; Brassicaceæ, Lind.) is a hardy perennial, a native of the shores of Britain, and which has been cultivated for more than a century, but most extensively within the last fifty years. Formerly the green leaves were used boiled as greens; but now the young blanched shoots are the parts used, and the chief aim in its cultivation is to produce these large, crisp, and well blanched.

Soil and Situation.—The situation for a plantation of sea-kale should be open to the sun, and not under the drip of trees. The best soil is a rich, deep, sandy loam, but the plant will succeed in any good garden ground that is not stiff. The kinds of manure that were recommended for asparagus will also be suitable for sea-kale. The ground should be trenched to the depth of from 2 to $2\frac{1}{2}$ feet, and according as it is poor or rich, more or less farm-yard or other manure should be well incorporated with it.

Cultivation.—Sow in rich soil in March, or as early in April as possible, in rows 1 foot asunder, and thin the plants to 6 inches apart in the rows. Stir the ground, and keep the plants clear of weeds during the season. Towards midsummer, a sprinkling of salt or of nitrate of soda may be applied with beneficial effects. Either of these salts may be sown over the leaves of the plants as well as on the ground, and no injury will result.

In the following March, the ground being trenched and duly prepared, commence at $2\frac{1}{2}$ feet from the side of the quarter, and mark three rows at $2\frac{1}{2}$ feet apart. Then a 3-feet space should be allowed; and again three rows should be marked off at $2\frac{1}{2}$ feet apart, and so on. If ground is scarce, it will nevertheless be advisable to retain the distance of 3 feet between every third and fourth row; but between the others an interval of only 2 feet may be allowed. This distance will also be proper for a plantation which is to be forced, only the plants should be 2 feet apart in the row, in order to admit of blanching pots being placed over them.

When the plants are taken up, the top of each with all the crown buds should be pared off. If this precaution be not taken, the plants would be apt to run to seed in the first summer after planting; but when the crown is cut

off several buds will push which will not have this tendency. A trench about 1 foot deep should then be made by the side of a line, and the plants inserted so that their crowns may be about 2 inches below the surface. Watering after planting is not required, at least till the plants have struck fresh root.

After planting, the growth of the plant should be promoted as much as possible, and with this view a mulching of rotten dung may be applied, or liquid manure may be occasionally given. The flower-stems, if any push, should be cut off as they appear. Buds will be formed in the axils of each leaf, and in the spring of the second year of planting, they will form a sprout which becomes fit for use when blanched, and, of course, the larger and more vigorous it is the better. Its strength greatly depends on that of the bud, and this again on the size of the leaf in the previous autumn; efforts should therefore be made to grow only large leaves. In order to do this, it is advisable to make an early removal of some of the weaker ones, so that a limited number may have more light and air. If some very large sprouts are intended to be grown, the plants should be kept far apart. In the autumn the leaves should be removed as they decay, and, when all are cleared off, the ground should be forked over, and a covering of leaves, 6 or 8 inches thick, placed over the plants, and on this some litter should be put to prevent the leaves from being blown away. If leaves are not at command, the plants may be covered with 6 or 8 inches thick of light soil, and by this means they will be blanched, though not forced.

Instead of sowing in a nursery bed, and transplanting the year-old seedlings, some prefer sowing the seed in patches, at the proper distances, where the plants are to remain for produce. This is certainly the more natural mode, and well-established plants can be obtained by it; the only objection is the loss of the ground for a year. The plants should be allowed to follow their natural mode of growth during the first summer, but after the winter is over, the crowns of every plant should be pared off, as was recommended in transplanting, to prevent the formation of flowering stems. In the second spring after sowing a portion may be blanched if required.

Plantations may also be made from cuttings of the roots, for any part of these will push shoots, and form a plant. The extremities of

the roots of plants taken up for forcing, in November, or subsequently, answer very well. Being the younger portions of the roots, they ultimately make better plants than would result from transplanting the older and thicker parts. These *thongs*, or extremities of the roots, should be cut in lengths of about 4 inches, and laid in a heap till the time of planting, in spring. Cuttings should not be taken from any but very healthy plants, a few of which will afford enough to make a moderate plantation.

Taking the Crop.—The blanched sprouts should be cut when they are from 3 to 6 inches in length, and whilst crisp, stiff, and compact; they should not be left till they are drawn up so as to bend or hang down. The soil or other material used for excluding the light should be carefully removed so as to expose the stem of the sprout, and the latter should be cut a little below the base of the petioles, and just enough to keep these attached.

To save Seed.—Select some strong plants, and allow them to take their natural growth, without cutting off the crowns, or blanching. When the seed is ripe, collect the pods, dry them, and put them into open canvas bags. The seeds keep best in the pods.

SHALLOT (*Allium ascalonicum*, L.—Hexandria Monogynia, L.; Liliaceæ, D. C.; Liliaceæ, Lind.)—The shallot is a hardy perennial, a native of Palestine, found near Ascalon; hence the specific name. The bulbs, which are milder in flavour, and do not possess such an offensive odour as those of garlic, are used in a raw state for flavouring steaks and chops; and boiled, in soups, stews, and some other dishes.

The varieties are:—

1. COMMON SHALLOT.
2. LONG-KEEPING SHALLOT.
3. JERSEY, OR RUSSIAN SHALLOT.
4. GROSSE ECHALOTE D'ALENCON.

The second sort will keep nearly two years, and is not so liable to be attacked by vermin at the root as is the case with the variety generally cultivated. The Jersey shallot has very glaucous leaves, and is much earlier than the other sorts; but the bulbs do not keep so long. The leaves of the fourth sort resemble those of the preceding; the bulbs are slower in forming, but acquire a much greater size. It produces the largest bulbs of any, but the worst keepers, as, when stored, they soon begin to push.

Much dependence cannot, however, be placed in these varieties, for they are all extremely liable to degenerate in two or three years to the common sort.

The shallot requires a rich, free, and rather dry soil, not recently manured, and a warm aspect. In recently manured, and in damp ground, the bulbs are very liable to be attacked by the maggot; in such, therefore, it should never be planted. It is propagated by planting the cloves 6 inches apart, in shallow drills 1 foot asunder, leaving the points of the bulbs a little above ground. Formerly the bulbs were planted 2 or 3 inches deep; but in moist soils and wet seasons they were very liable to rot when so treated. Mr. Knight, having found that his crops of shallots, planted in the usual manner, had, during several years, become mouldy, and perished, and that the same thing frequently occurred in other gardens in his vicinity, adopted the following mode of culture with very successful results.

A few bulbs, divided as far as practicable into single buds, "were planted upon the surface of the ground, or rather above it, some very rich soil having been placed beneath them, and the mould having been raised on each side to support them, till they should become firmly rooted. This mould was then removed by the hoe and watering-pot, and the bulbs in consequence were placed wholly out of the ground. The growth of these plants now so closely resembled that of the common onion as not to be readily distinguished from it, till the irregularity of form, resulting from the numerous germs within each bulb, became conspicuous. The forms of the bulbs, however, remained permanently different from all I had ever previously seen of the same species, being much more broad, and less long; and the crop was so much better in quality, as well as much more abundant, that I can confidently recommend the mode of culture adopted to the attention of every gardener."—(*Horticultural Transactions*, vol. ii. p. 98.) A small plantation to afford young bulbs in June and July may be made in the middle of October, or from that to the beginning of November; but the principal crop should be planted in February or the beginning of March.

The ground must be kept free of weeds, and in wet seasons it is a good practice to remove the earth from about the bulbs, so that they may be wholly out of the ground. In July or August, when the leaves turn yellow

and dry up, the bulbs may be taken up, and, having been exposed to the sun for several days to dry, they should be placed in nets, or tied up in ropes like onions, and then hung up in a dry airy room into which frost cannot penetrate.

SKIRRET (*Sium Sisarum*, L.—Pentandria Digynia, L.; Umbelliferae, D. C.; Apiaceae, Lind.) is a perennial plant, a native of China and Japan. The roots, which are the part used, are composed of several prongs about the thickness of a finger, joined together at top. They were formerly much esteemed, but their taste being disagreeable to some palates, the plant is now seldom cultivated. The roots are boiled, and afterward served in the same way as those of salsafy and scorzonera. It succeeds best in a free, rich, deep soil, and in an open situation. It is generally raised from seed, but may also be propagated by slipping off the side shoots in spring, before they begin to shoot. Each of these must be furnished with at least one eye or bud, and they should be planted in a shallow trench, with their crowns 1 inch below the surface. This method is, however, seldom practised; for not only is it more troublesome, but the roots produced are neither so large nor so tender as those yielded by plants raised from seed. It should be sown in the end of March, or in April, in drills 1 foot apart. In dry weather the bed should be watered, and when the young plants are about 2 inches high, they may be thinned out to 6 inches asunder. The ground should be slightly stirred, and frequent waterings given in dry weather. This will greatly tend to increase the size and tenderness of the roots. Some of these may be taken up young in September, and they will be in perfection in November, and continue so till the plants begin to exhibit signs of pushing up flower-stems, when they should be taken up and stored in sand. The flowers are white, and appear in July and August. The seed ripens in autumn. It should only be saved from the plants which flower the second year, for that produced by those which run the first season is generally worthless.

SORREL (*Rumex*, L.—Hexandria Trigynia, L.; Polygoneae, D. C.; Polygonaceae, Lind.)—The leaves of sorrel are used in soups, salads, and sauces, especially on the Continent, where they are also used as spinach.

Three species and several varieties are cultivated:—

I. COMMON SORREL (*R. acetosa*, L.) a perennial, a native of Britain, where it grows naturally in meadows and pastures. The flowers of this species are dioecious. The varieties are:—

1. COMMON GARDEN SORREL.
2. BELLEVILLE SORREL (*Oseille de Belleville*).
3. BLISTERED-LEAVED SORREL (*Oseille à feuilles cloquées*).

The second sort is the best; its leaves are larger than those of the common sort, and not so acid. It is the kind generally cultivated near Paris. The third sort has also large leaves, the surface of which is blistered; it is slow in running to seed.

II. FRENCH SORREL, also called Roman or Round-leaved Sorrel (*R. scutatus*, L.), is a hardy perennial, a native of France and Switzerland. Its stem is trailing, and rises from 12 to 18 inches high; the leaves are roundish, heart-shaped, entire, glaucous, and smooth; the flowers are hermaphrodite. The leaves are more acid than those of the preceding species, on which account they are preferred by many persons.

III. MOUNTAIN SORREL (*R. montanus*, H.P.), a hardy perennial, a native of the same countries as the preceding, is dioecious. There are two varieties of this species:—

1. MOUNTAIN SORREL (*Oseille vierge*).
2. GREEN MOUNTAIN SORREL (*Oseille vierge verte lisse*).

These are both of French origin. The leaves of the first sort are slightly blistered, larger than those of the common sorrel, of a paler green, and not so acid. It is an excellent sort, and does not run quickly to flower. The leaves of the Green Mountain sorrel possess much acidity, are of darker green, larger, more abundant, and earlier in spring than those of the preceding sort. It is the latest in running to flower, and is considered to be preferable to any of the other sorrels. The male individuals of *R. montanus* are mentioned in the *Bon Jardinier* as well adapted for being planted as an edging in the kitchen garden.

Sorrel grows well in almost any soil, but succeeds best in one that is rich, deep, and rather moist. All the sorts may be propagated by dividing the roots in March or April, and this method is that which must be adopted in propagating the dioecious kinds when male plants are required. It may also be raised from seed, sown at the same time, or in autumn; the best plants are obtained from seed,

but the varieties when sown are apt to return to their original type. The seed may be sown either broadcast or in drills, on well-dug ground, raked fine, and it should be covered with fine earth to the depth of $\frac{1}{2}$ inch. The distance between the drills may be 15 inches for the small-leaved sorts, and 18 inches for the large-leaved kinds. When the young plants are 2 or 3 inches high, they should be thinned out to 1 foot apart in the row, and the thinnings may be planted at the above distances, water being given at planting, and afterwards till they take root. About two months after sowing, some of the leaves may be gathered. In doing this, the plants are generally cut over; but the market gardeners near Paris prefer gathering the leaves singly, always taking those which are full grown, leaving the younger to increase in size, and this is the best plan. As the acidity of the leaves is increased in the heat of summer, a small quantity to come in for use at that season should be sown or planted in a shady, and rather moist border. All the care necessary, is to hoe the ground between the rows occasionally, to fork it in spring or autumn, and to take up the plants, divide, and replant them every three or four years, or less frequently if they are growing vigorously and produce full-sized leaves.

SPINACH (*Spinacia oleracea*, L. — Dioecia Pentandria, L.; Chenopodeæ, D. C.; Chenopodiaceæ, Lind.) is an annual plant, supposed by some to be a native of Northern Asia, but its native country is not certainly known.

The varieties, which are few, may be divided into two classes:—I. SMOOTH-SEEDED. II. PRICKLY-SEEDED.

I.—SMOOTH-SEEDED.

1. SUMMER SPINACH—syn. Round Spinach, Spring Spinach, Thick-leaved Round Spinach, Epinard de Hollande, Epinard rond.—Leaves large, roundish, and thick. This sort is adapted for summer use; all the others for winter supply. In consequence of its soon running to seed, it requires to be sown frequently.

2. FLANDERS SPINACH—syn. Epinard de Flandre, Epinard de Flandre à très larges feuilles.—Leaves large, hastate, from 6 to 8 inches in breadth. It is a hardy and good winter spinach.

3. LETTUCE-LEAVED SPINACH—syn. Epinard d'Esquermes, Epinard à feuilles de laitue.—Leaves very large, rounder than those of the

preceding sort, of thick substance, and of a dark green colour. It is not perhaps quite so hardy as the Flanders spinaeh, but on account of its superior quality, at least half of the ground allotted for the winter crop should be occupied by it. A variety called the *Epinard Gaudry* appears to be the same as this sort; at least it is very similar to it.

II.—PRICKLY-SEEDED.

4. PRICKLY-SEEDED—syn. Winter Spinaeh, Bordeaux, *Epinard commun* of the French.—Readily distinguished by its seeds being prickly. Leaves smaller and thinner than those of the Flanders and Lettuce-leaved, to which varieties it is inferior in everything but hardness.

The soil for spinach should be deep and rich, neither very stiff, nor very light. The ground for the summer sowings should be rather moist, otherwise frequent waterings will be necessary; whilst for the winter crops a dry, warm spot must be selected. In all cases the ground should be deeply dug, and, if necessary, manured with stable-dung. Blood, guano, and other nitrogenous manures, are also used with advantage.

The first sowing of the Summer spinach may be made in the middle of February, and from that time a small quantity should be sown every three weeks till the beginning of May, afterwards a small sowing may be made every ten days till August, if a constant supply is required, for the summer crops soon run to seed. In the first week in August, and again in the third week of that month, the principal crop of Flanders and Lettuce-leaved spinaeh for winter use should be sown; and lastly, another sowing of the same kinds may take place in the beginning of September. The sowings for summer use should be made in a somewhat shady situation, with the view of preventing the plants from running to seed so soon as they otherwise would. Frequently, the summer crops are sown in a single drill between rows of pease or beans; in this way they do very well, and in rich soil do not injure the plants between which they are grown.

The ground having been deeply dug, the seed should be sown in drills about 1 inch deep, 12 inches apart for the Summer spinach; but for the Flanders and Lettuce-leaved varieties, from 15 to 18 inches between the rows may be allowed. The winter crops are also frequently sown broadcast, in 4 or 5 feet beds,

with 1-foot alleys between. Previous to sowing, if the ground is dry, the drills should be well watered; it is also advantageous to steep the seeds before sowing for five or six hours, when their speedy germination is desired; but in this case they must not afterwards be allowed to get dry, nor suffer from want of water.

After sowing, the seed-bed should be frequently watered in dry weather. When the young plants have made three or four leaves, they should be thinned out to about 2 inches apart; afterwards, when rather further advanced, they may be thinned out to 6 inches apart in the rows, for the Summer spinach; but the other kinds should be allowed 9 inches between the plants. Some, before thinning the summer crops a second time, make a first gathering, and then cut out every alternate plant. After thinning, the culture is confined to keeping the ground clean, stirring occasionally, and watering frequently and copiously in dry weather. In gathering for use, the largest leaves should be taken off first, either by cutting or picking, the others being left to produce in succession; but during the heat of summer the plants may be cut over.

To save Seed.—Seed of the Summer spinaeh may be saved from plants of the early spring sowings; and to obtain that of the winter kinds, a portion may be transplanted in spring. After fertilization has taken place, all the male plants may be at once removed. The seed remains good for two or three years.

SUCCORY. See CHICORY.

SWEET CICELY (*Scandix odorata*, L.—*Pentandria Digynia*, L.; *Umbelliferae*, D. C.; *Apiaceae*, Lind.) is a hardy perennial, a native of Britain. In this country the leaves were formerly put into salads, but the strong flavour of aniseed, which the whole plant possesses, renders them disagreeable to most persons. It is no longer cultivated in Britain, but the leaves and roots are still used in France; the former for the same purposes as those of chervil; the latter in soups, to which they are said to communicate an agreeable taste. The plant will grow in any situation, and may be raised from seed, which is best sown in autumn.

TANSY (*Tanacetum vulgare*, L.—*Syngenesia Polygamia Superflua*, L.; *Compositae*, D. C.; *Asteraceae*, Lind.) is a hardy perennial, a native of Britain. The young aromatic leaves are employed in colouring and flavouring puddings, &c.

Two varieties are cultivated:—

1. COMMON TANSY.
2. CURLED TANSY.

The second sort is the most esteemed, and the one generally cultivated.

Tansy may be raised from seed sown in spring, but is usually propagated by dividing the roots in February or March, or in autumn. The divisions should be planted 1 foot apart, in rows 18 inches asunder. The ground between the rows should be hoed and loosened occasionally; no other culture is necessary. By topping the plants before they come into flower, the production of young leaves will be encouraged. The plants will continue many years in the same place; but in a few seasons they exhaust the soil, so that the leaves are not so tender; therefore a new plantation should be frequently made in fresh soil.

TARRAGON (*Artemisia Dracunculus*, L. — Syngenesia Polygamia Superflua, L.; Compositæ, D. C.; Asteraceæ, Lind.) is a perennial plant, a native of Siberia. The aromatic leaves and tops are used in salads and soups, are pickled with gherkins, and an infusion of them in vinegar forms the much esteemed tarragon vinegar. It requires a free, light, and somewhat dry soil, and a warm situation. It is propagated by dividing the roots in March or April, planting them in deeply dug ground, 8 inches apart, in rows from 12 to 15 inches asunder, covering the roots with soil to the depth of 2 or 3 inches. It may also be propagated by cuttings of the shoots, taken off in July or August, planted under a hand-glass, and transplanted when they have made good roots, water being given at planting and until they are established. As the plants are liable to be injured by severe frost, it is a good plan to cut them down at the approach of winter, and to cover the crowns with a little mould and then with litter. In spring the ground should be slightly stirred, but not so deeply as to injure the roots. A fresh plantation should be made every year; for tarragon, though a perennial, is apt to die off in this climate, seldom lasting good for more than two or three years. Where not forced in winter, a quantity should be cut and dried for use in that season.

TETRAGONIA EXPANSA. See NEW ZEALAND SPINACH.

THYME (*Thymus*, L. — Didynamia Gymnospermia, L.; Labiata, D. C.; Lamiaee, Lind.) — The leaves and tops of thyme are extensively

used in soups and stuffings, for which purposes two species are cultivated, namely, COMMON THYME and LEMON THYME.

I. COMMON THYME (*Thymus vulgaris*, L.) is an evergreen under shrub, a native of the south of Europe. Of this there are three varieties:—

1. NARROW-LEAVED COMMON THYME.
2. BROAD-LEAVED COMMON THYME.
3. VARIEGATED COMMON THYME.

The first two sorts are those cultivated for culinary purposes, the other being chiefly grown for ornament,

II. LEMON THYME (*Thymus citriodorus*, Pers.) is a low evergreen shrub, of a trailing habit, and rarely exceeding 4 inches in height. Its native country is not known. Its smell is exceedingly pleasant, and, on account of the flavour, it is preferred to the common sort for some dishes.

Thyme is always most aromatic, and thrives best when planted in a light, rich, and rather dry soil, and in a warm situation. It may be propagated by seed, by dividing the plant, or by rooted branches; the last is the mode in which Lemon thyme may be most readily propagated. The best plants are raised from seed. This should be sown in April, on a bed of light earth raked fine. They may be sown broadcast, in shallow drills 8 inches apart, or in a single drill to form an edging; in all cases covering lightly with earth. The seed-bed and the young plants, when they come up, should be watered occasionally in dry weather. They may be thinned out in June or July to 4 inches apart; or, if sown in drills, to about 3 inches apart in the row. The thinnings may also be planted, water being given at planting, and subsequently till they take root.

Old plants may be divided in March or April, and rooted branches may be taken off and planted at the same period, in both cases watering at planting. Branches may be induced to take root by bending them down and covering the lower portion with earth, when they will soon take root.

Thyme is frequently planted or sown as an edging, and answers the purpose very well; but after the lapse of three or four years, or when the edging commences to exhibit gaps, the plants should be taken up. When coming into flower a quantity should be cut, or pulled up, and dried for winter use.

TOBACCO (*Nicotiana Tabacum*, L. — Pentandria Monogynia, L.; Solanæ, D. C.; Solana-

ceæ, Lind.)—The tobacco is an annual plant, a native of South America, now cultivated in all the warmer regions of the globe. Its cultivation in this country for sale is not only absolutely prohibited, but even if it were allowed it could not be profitably carried out on account of the inferior quality of the produce in our climate, the exhausting nature of the crop, and high rent of the land. Leaves, however, can be produced in this country of a quality which is found to answer exceedingly well for the destruction of insects, and its cultivation in gardens for this purpose is desirable, as the heavy duty on the imported article is saved by so doing. Although it is unlawful to plant tobacco except for medicinal purposes, and even then the quantity must not exceed half a pole, yet we are not aware of any instance in which the growing of it for the destruction of insects has been objected to by the excise authorities; nevertheless, it is advisable to obtain their permission in the first place.

Many varieties are distinguished: two of the best are the BROAD-LEAVED VIRGINIAN and the GUATEMALA TOBACCO. The leaves of both these are very similar; but the former has pink, the latter white flowers.

Tobacco is raised from seed, which should be sown on a moderate hot-bed about the middle of March, and covered lightly with fine earth. The after management in the garden of the Horticultural Society at Chiswick is thus described by Mr. John Wilson:—

“When the plants were come up, and had acquired sufficient strength, they were pricked into shallow pans, about 2 inches apart; they were then gradually inured to the open air on good days, and finally planted out in the middle of May, at 3 feet apart, in rich ground. They were shaded with flower-pots, and occasionally watered, till they had taken root and begun to grow. No more attention was bestowed, except keeping the ground clean, until their lateral shoots began to show themselves, which were constantly kept pinched off as they appeared: these, if suffered to remain, would have had the effect of very much reducing the supply of sap from the useful leaves of the plants; they were topped at sixteen or eighteen leaves, according to their strength. The tobacco was ripe in the beginning of September, as was indicated by the leaves becoming mottled with yellow spots, those at the bottom more so than at the top of the plant;

they were also more glossy and shining than before.

“The mushroom-house, being at this time disengaged, was thought an eligible place for the curing process. The plants were taken up quite dry, with a few of their roots; but no particular attention was paid to saving many of the latter, as the object was only to avoid breaking the bottom leaves (which might have been the case by cutting the stems); the plants were carried immediately to the house, and hung on nails in the walls, and on ropes in the middle of it. When all had been brought into the house it was shut up quite close, the fire lighted, and the temperature kept to 70°, until the leaves got completely yellow, which they did in four or five days. The heat was then raised to 75°, and, in about a week, the leaves, with the exception of the midribs, were cured, and of a fine brown colour. The heat was then increased to between 80° and 90°, and in five days the midribs were so completely killed, that the thick ends of them would have broken immediately on attempting to bend them. The leaves were now very much curled, and dry as fire could make them, and, if subjected to any pressure, would have crumbled to snuff. Fire was discontinued, and the floor of the house well watered; this was repeated as it evaporated; and, in twenty-four hours, the leaves were as soft and pliable as could be desired: they could now be handled without breaking or wasting them. When stripped off the stalks they were stretched out singly, and laid above one another, smoothing them gently with the hands; when all were laid out neatly, they were well pressed to give them form and keep them smooth; they were then tied in *hands* of about half-a-dozen leaves in each, and packed into a tub, being well pressed as they were put in. In this way they remained a fortnight, when they began to mould slightly at the midribs, in consequence of the weather being moist and warm; they were then rehung in the house, and very gradually dried by fire heat; were afterwards brought to a moist state in the manner above described, and finally were repacked in the tub. The important points in the above mode of curing are, to carry the plants to the house whenever they are taken up; for, if the sun be bright, the leaves would sunburn in a short time; the leaves require to be yellow before the heat is increased, otherwise the tobacco would cure too light-coloured; and the midribs

must be completely killed before the leaves are taken off the stalks; for, if not once made very dry, they would never keep.

"The number of leaves that each plant ought to be allowed to produce should be determined by the quality of the ground, the earliness or lateness of the season, &c.; where these combine to the advantage of the plants, they are able to perfect proportionally more leaves."—(*Horticultural Transactions*, second series, vol. i. p. 213.)

In curing, merely drying the leaves is not sufficient, for the addition of water is necessary for the formation of *nicotine*; and a slight fermentation is also said to assist in producing the same effect. It is to the presence of nicotine that tobacco owes its poisonous properties; hence, where due attention has not been paid to the formation of this organic base, the tobacco is not unfrequently rendered totally unfit for fumigation, proving more injurious to the plants themselves, than to the insects which it is intended to destroy.

TOMATO, The, or Love Apple (*Lycopersicum esculentum*, Dunal; *Solanum Lycopersicum*, L. —Pentandria Monogynia, L.; Solanaceæ, D. C.; Solanaceæ, Lind.) is a tender annual, a native of South America, and some say of Mexico as well. It is cultivated for its fruit, which forms the principal ingredient of various sauces; and it is also used in soups, and made into a pickle when in a green state.

The varieties are:—

1. LARGE RED.
Tomate grosse rouge.
2. SMALL RED.
Tomate petite rouge.
3. CHERRY TOMATO.
Tomate Cerise.
4. PEAR-SHAPED.
Tomate en poire.
5. EARLY RED.
Tomate rouge hâtive.
6. LARGE YELLOW.
Tomate grosse jaune.
7. SMALL YELLOW.
Tomate petite jaune.

The Large Red is the best, and most generally cultivated both in this country and in France. The fruit sometimes weighs as much as 12 oz., and a single plant will produce from 20 to 40 lbs. of fruit. The Early Red resembles the preceding, but is earlier. It is the sort forced by the market gardeners near Paris.

The tomato is raised from seed, which should be sown in February or early in March, either

in pots placed in gentle heat, or on a moderate hot-bed; in either case the plants should be potted off, singly, into small pots, as soon as they have made their second leaves. As the plants increase in size, they should be shifted into larger pots, and plenty of air and water ought to be given. An occasional application of liquid manure will also be found beneficial. As the weather gets warmer, they must be more and more exposed to the air till the end of May, when, if the weather is favourable, they may be planted out against a wall or paling, with an east, west, or south aspect; the latter, however, is indispensable in cold localities, both in England and Scotland. If neither of these be at command, they may be planted in warm situations, in the open ground, or better, at the foot of a bank sloping to the south, with an inclination of about 45° more or less, as the soil will permit. By planting in this way, due attention having been given to training, removing superfluous branches, and thinning both fruit and leaves, Mr. Wilmot of Isleworth obtained, in a warm season, 400 half-sieves of ripe fruit from 600 plants.

In planting, holes 1 foot in depth should be made, and in them should be put a quantity of rotten dung, which must be covered with 4 or 5 inches of earth. Water ought to be given at planting, and subsequently in dry weather. As the branches increase in length, they should be nailed rather widely apart, to the wall or fence, the object being to expose the fruit as much as possible to the sun's rays, without at the same time depriving the plant of its due proportion of foliage; or, if the plants are grown on a sloping bank, they may be pegged down. Shoots, where too close together, or likely to cause confusion, should be thinned out; but much foliage should not be removed at one time. Some almost entirely strip the plant in order that the sun may colour the fruit, but it should be recollected that this colouring without the action of the leaves, does not constitute perfect ripening. When as much fruit is set as is likely to ripen, and it is only those earliest formed that will do so in this country, the plants should be stopped by pinching. This operation must also be performed above the fruit on each of the secondary branches; and laterals should be removed, but not all at one time. Afterwards all leaves that tend to shade the fruit from the sun should be taken off. The fruit ripens in August, September, and October; it should be gathered as it succe-

sively comes to maturity, and when perfectly dry; if hung up in a dry place, it will keep till November. Before frost sets in, all fruit not perfectly ripe should be gathered and placed in a vinery or peach-house to complete its maturity; but fruit so ripened, though useful, is never so good as that matured on the plant.

Although the tomato is generally raised from seed, it may also be propagated by cuttings, a plan which, from the following statement of a correspondent of the *Gardeners' Chronicle*, appears to be attended with some advantages. He says:—

“Living not very far distant from Manchester, I cannot boast of having the largest share of sunny days, but for fog and smoke I believe we can vie with any district in the kingdom. Nevertheless, I generally succeed in getting a good supply of tomatoes, well ripened, before autumn frosts set in. I propagate by cuttings, putting them in about the beginning of September. I need scarcely state, that the lateral shoots are preferable to the leading ones. They strike readily, either singly in small pots, or two or three together in larger ones; but I prefer the former method, as their roots are not so liable to get injured in potting. As soon as the plants are well rooted they are shifted into 5-inch pots, in which they remain till about the beginning of February, when they are repotted, giving them a decent shift; nothing more is required except attention, &c., till planting out time. The tops may at this time be taken off and struck; they make excellent plants, fully the best, by the middle of May. The only objection to this system is the difficulty of keeping them over winter; but if one half of the plants only lives, the certainty of a crop will amply repay the trouble. Not only do plants raised in this way bear and ripen sooner than those produced from seed, but the fruit is both larger and there is more of it.”—(*Gardeners' Chronicle*, 1852, p. 70.)

The above is a good plan to adopt in cold situations. But in these there is always much uncertainty as regards perfect ripening; and where there is the means, it is better to grow the plants in a pit or in pots, which may be moved into any house where there is sufficient heat and light. In ripening off they will bear the heat of a pine stove.

TREE PRIMROSE (*Oenothera biennis*, L. — Octandria Monogynia, L.; Onagrarieæ, D. C.; Onagraceæ, Lind.)—This is a hardy biennial

plant, a native of Virginia, but naturalized in many parts of Europe. It is cultivated in Germany for its long fusiform roots, which are cooked in various ways. The following details respecting the method in which it is cultivated and used in that country, are translated from the *Bon Jardinier*:—“It is sown thinly broadcast in April, on well-dug ground, and when the young plants have made a few leaves, they are planted in quincunx order, at from 12 to 20 inches apart, in ground manured the previous autumn. During the summer the ground is kept clean, and the plants watered when necessary; in the autumn the roots are taken up, deprived of all the leaves, with the exception of the heart-leaves, and stored in a cellar; or they are left in the ground and taken up as required, for the plant is perfectly hardy. The roots are eaten boiled, either cut into slices and put in salad, or served up with white sauce like the roots of salsafy. They are also put into soups. This vegetable is recommended for weak stomachs, being easy of digestion, and nourishing at the same time. It is not used after Easter, as the roots by that time become hard and woody.”

TROPÆOLUM TUBEROSUM (Octandria Monogynia, L.; Tropæoleæ, D. C.; Tropæolaceæ, Lind.) is a perennial plant, a native of Peru, deserving of mention as a recently introduced esculent. It produces an abundance of pretty yellow and red tubers, about the size of small pears, the taste of which is not, however, very agreeable. On this account a particular mode of preparation is adopted in Bolivia, where, according to M. Decaisne, they are treated in the following manner:—

“The tubers of the *Tropæolum tuberosum*, designated *ysano* at La Paz, require to be prepared before they become edible. Indeed, when they were prepared in Europe like potatoes, and immediately after being taken up, their taste was very disagreeable. But a mode of making them palatable was discovered in Bolivia, and the *ysano* has there become, if not a common vegetable, at least one which is quite edible. The means of making them so consists in freezing them after they have been cooked, and they are eaten when frozen. In this state M. Weddell affirms that they constitute an agreeable dish, and that scarcely a day passes at La Paz without two lines of dealers being engaged in selling the *ysano*, which they protect from the action of the sun by enveloping it in a woollen cloth, and straw.

"The ladies of La Paz are all very fond of the ysano; and in the season of the *taiachas* large quantities are sopped in molasses, and taken as refreshment during the heat of the day."—(*Journal of Horticultural Society*, vol. ix. p. 59.)

This plant may be propagated by pieces of the tubers in the same manner as potatoes, an eye being preserved on each piece. The sets should be planted in April, about 4 feet apart, in light rich soil. The stems may either be allowed to trail along the ground, or pea-sticks may be placed for their support; in dry soils and seasons, the former method should be adopted; in those which are moist, the latter. The tubers are taken up in October or November, when the leaves begin to decay, and stored in sand.

TRUFFLE (*Tuber cibarium*, Sibth.—*Cryptogamia Fungi*, L.; *Fungi*, D. C.; *Alliance*, *Fungales*, Lind.)—The common truffle is nearly spherical in shape, and when full grown rarely exceeds the size of a large walnut. The surface is rough, warty, and of a black colour. The flesh is grayish, or white, when young, black veined with white, when old. The smell is powerful, but by no means unpleasant. It grows from 2 to 10 inches under the surface of the ground, and the spots where it is to be found are discovered by means of dogs trained for the purpose. It is abundant in some parts of Britain, particularly in Wiltshire, Kent, and Hampshire; but never occurs in any but calcareous soils, where it grows under the shade of trees, generally the oak and beech. In warm moist years it may be found throughout the year, but most abundantly from August to October.

Truffles constitute a much esteemed luxury, seldom indulged in by any but the rich. They are used in sauces, gravies, and in a great variety of dishes; indeed, it is an axiom with first-rate French cooks that the truffle improves all that it touches. There is, however, no doubt that they are indigestible, and injurious to the health when eaten in large quantities.

Besides the common species, there are other and more esteemed sorts, not found in this country, which are imported from the Continent, and always command a very high price in our markets. The most celebrated of these is the Piedmontese truffle (*Tuber magnatum*), which is sold at an enormous price. It occurs abundantly in the mountains of Piedmont, and

probably nowhere else. The truffle of the Paris markets (*Tuber melanosporum*), is richly scented, and also greatly superior in flavour to the common sort.

Although much has been written on the cultivation of the truffle, yet all attempts to grow it anywhere but in the localities where it naturally occurs have terminated unsuccessfully. Some account of the methods proposed may, however, afford useful hints to our readers. The first person in this country who called attention to the possibility of cultivating it, appears to have been Bradley, who has the following observations on the subject, in a work entitled *New Improvements of Planting and Gardening, both Philosophical and Practical*:—

"The truffle may be easily cultivated where there are woods or coppices of oak or hazel, and where the soil is not too stiff or inclining to chalk. The soil where they are most found is a reddish sandy loam. This will then be the best for our purpose, especially if it has lain long uncultivated. When we are thus provided with the proper soil we must be sure to let it lie undisturbed till we are ready to plant, which will be in the months of October, November, and December, if the weather be open; for then the truffles are to be found in their full ripeness, and then likewise one may find them in a state of putrefaction, which is the time when the seeds are prepared for vegetation; it is in the last state that one ought to gather truffles for planting, or at least they should be in perfect ripeness.

"The proper soil and these rotten truffles being found, we may begin our work as follows:—Open a spot of ground of a convenient space, and take out the earth about 8 inches deep, and screen it, that it may be as fine as possible; then lay about 2 or 3 inches thick of this fine earth at the bottom of the trench or open ground, and upon it lay some of the over-ripe truffles, about 1½ foot distance from one another; and as soon as possible prepare a thin mud, made of the screened earth and water, well mixed together, and pour it on the truffles till the opened ground is quite filled up. By this means, in a few hours, the ground will be as close settled about the truffles as if it had never been dug or disturbed at all, and you may expect a good crop in due time. You must, however, take care to choose your spots of ground in woods or coppices, or such places as are shaded with trees."

The method proposed by Bradley does not

appear to have been successful; that of the Comte de Borch, whose work upon the subject appeared at Milan in 1780, is said to have been attended with a better result.

"The Comte de Borch, previously to commencing his researches into the mode of propagating truffles, took an opportunity of examining the growth of the singular conglomerations of clay and fungus-spawn, which are known in Italy by the name of *Pietra fonghosa*. These are not only objects of curiosity in consequence of their producing, when properly watered, a crop of fungi, but the fungi so produced form an excellent article of food. They are not often brought over to this country; but I have seen in an herbarium a specimen produced from one of these fungus-stones in England. The comte first removed a lump of the spawn from the surrounding earth, and contented himself with simply watering it, and under these circumstances it produced a pileus, which, however, withered when it had attained a certain height. He then as closely as possible imitated the soil of which the agglomerations were composed, and placed one of them in the centre of it, and after repeatedly sprinkling it with water, in which some fungi of the same species had been washed, he had then an excellent crop, which were distributed to many of his friends. He determined to keep this in view in his experiments on truffles.

"His attention was directed chiefly to the nature of the soil in which the particular species of truffle, on which he experimented, grew. He found that it was a light soil, mixed with particles of imperfectly decomposed vegetable substances, with a slight admixture of clay, and that a moist but not wet condition of it was most favourable to their development. He therefore prepared an artificial soil of such a description as that in which he found the truffles most abundant. It was composed of seven parts of good garden earth, two of light argillaceous soil, and one of oak sawdust; this was intimately mixed together, and abundantly sprinkled with rain-water. It was then exposed to the full sun till the moisture was absorbed to the degree he wished, and in the soil thus prepared he placed four truffles of the best quality, but without any favourable result, as they all gradually became mouldy.

"He then paid close attention to the structure of the truffle itself, and he was led to suspect the existence of reproductive bodies in the veins, and having carefully collected a quan-

tity, he had the satisfaction of finding, after forty-five days, a number of minute truffles.

"Having now ascertained that truffles were really propagated by seed, he thought that it would be more convenient to try the effect of planting whole truffles, and this plan proved successful. Having prepared an entirely artificial bed—or if the natural soil were preferable, taking care, after first trenching it to the depth of 2 feet and removing all large stones, to make such additions to it as should bring it as nearly as possible to the requisite condition, especially that of a due proportion of oak sawdust, and if the clay were at all too stiff, about one-tenth of pounded snail-shells, and choosing an aspect rather exposed to the north than the south, and where no reflected rays could fall upon it, with every precaution to insure its being thoroughly drained—he first watered it thoroughly with pure rain-water, and after waiting a day or two till it was in a proper state of moisture, he made rows $\frac{1}{2}$ foot deep, and in these, at 6 inches' distance, he placed good and sound truffles, each of them being surrounded with two or three handfuls of oak sawdust, taking care to mark the rows accurately. Ridges were then made over each row to prevent the truffles being injured by too abundant moisture; the bed was then left till the following autumn with no other precaution than in dry weather to take care that it did not become too dry. The result, we are informed, was an abundant harvest every year from October to January."—(Rev. M. J. Berkeley, in *Gardeners' Chronicle*, 1845, p. 223). With reference to the preceding method, it is necessary to observe that the experiment was confined to the Piedmontese species.

A treatise on the cultivation of the truffle, by Alexander von Bornholz, was published at Quedlinburg and Leipzig, in 1825; and a translation of it appeared in the *Gardener's Magazine*, vol. xiii., to which we would refer such of our readers as may be desirous of entering minutely into the details of the system proposed, of which the following is a short account:—

M. von Bornholz states, that whether a truffle plantation be made in a wood or in a garden, a somewhat moist soil, and a low situation should be chosen; at the same time the soil should be mellow, fertile, and by no means boggy. As truffles are finest and most abundant in a light, ferruginous, calcareous soil, such should be selected for the planta-

tion; and if a soil of this description does not naturally occur in the neighbourhood, it must be artificially formed. A pit from $2\frac{1}{2}$ to 3 feet deep should then be dug, and the sides and bottom lined with unburned calcareous stone, to prevent the burrowing of mice and other vermin; but where the subsoil is compact, the bottom should not be so lined. The pit is next to be filled to the depth of 1 foot with ferruginous calcareous soil, and the remainder of the space filled up with a compost of completely decomposed cow-dung, oak or hornbeam leaves, and wood soil, the whole of the ingredients having been thoroughly mixed. In this, young truffles are planted from 2 to 6 inches deep, and the whole covered with oak leaves, above which some branches of the oak or hornbeam should be placed, and some young plants of these trees inserted. If truffles are to be raised in gardens, a low, moist spot, shaded by trees, should be chosen, and a hole prepared and filled as before; but the compost used must contain a larger proportion of oak leaves, pounded bark, and spent tanners' bark. After planting, the bed should be covered every autumn with a layer of fallen oak leaves 1 foot in thickness.

It is very probable that the above method was merely theoretical. At all events there is no evidence to prove that successful results have been obtained.

In a review (*Gardeners' Chronicle*, 1852, p. 518) of M. Tulasne's *History and Monography of Truffles*, a beautiful but scarce work, it is stated that the production of truffles "can easily be effected in certain calcareous soils, even where they may not have been observed before. The plan consists simply in sowing acorns on the soil, and when the oaks have attained the age of ten or twelve years, truffles begin to appear. The extensive truffle layers of Loudon, in Vienne, were actually produced in this manner. They consisted a few years since of naked uncultivated plains, where truffles were unknown. The plantations must not be too thick; they are cut down for the first time when they are about twelve years' growth, and then at intervals of from seven to nine years. They continue fertile for about twenty-five or thirty years, when at length scarcely any truffles are produced."

Notwithstanding the failure of all the attempts which have been made to subject the truffle to cultivation, there is still much reason

to suppose that further experiments may terminate successfully. By ascertaining the chemical composition of the truffle itself, by the careful analysis of the soils in which it grows, by ascertaining their cohesion, their power of absorbing and retaining moisture, their temperature at various depths, the amount of moisture they receive, and by observing any other peculiarity of soil and situation, the conditions which it naturally enjoys may be discovered. Then, by systematic experiments, the conditions essentially necessary to its growth may be found, and a proper mode of cultivation arrived at. In conclusion, it may be observed, that though experiments may be carried on with the common species, yet success once obtained with that, attention should be immediately directed to the naturalization and cultivation of the more valuable foreign sorts.

TURNIP (*Brassica Rapa*, L.—*Tetradynamia Siliquosa*, L.; *Cruciferae*, D. C.; *Brassicaceae*, Lind.)—The turnip is a hardy biennial, a native of Britain, as well as of many other parts of Europe. It has been cultivated for its roots from time immemorial, and the leaves are also frequently used as greens, or sometimes blanched as a substitute for sea-kale.

The French turnip, a fleshy-rooted variety of *Brassica Napus*, which is sweeter and of better flavour than the common turnip, but inferior to it in size, is likewise cultivated for the same purposes; and the Swedish turnip (*Brassica campestris rutabaga*, D. C.) is sometimes, on account of its extreme hardiness, grown in gardens in very cold situations where other kinds are liable to be injured by frost.

The principal garden varieties of turnip are:—

1. **EARLY WHITE DUTCH**—syn. Turnep hâtif de Hollande, Rave de Limousin.—Bulb roundish-oblate or flattened, skin white; flesh white and very tender, but must be used in a young state, for after the bulb has attained its full size, its quality becomes much deteriorated; from 2 to $2\frac{1}{2}$ inches in diameter, is a good size for use. This sort has been long in cultivation, and is still the one principally employed for the earliest crops.

2. **EARLY FLAT WHITE**—syn. Navet blanc plat hâtif.—Bulb small, much flattened; flesh white and tender. A very early sort.

3. **ENTIRE-LEAVED EARLY FLAT WHITE**—syn. Navet blanc plat hâtif à feuille entire.—This is a variety of the preceding. The leaves

are not cut on the margins, and the bulb is round, handsomely formed, early, and of good quality.

4. **EARLY WHITE STRAP-LEAF**.—An excellent early variety, with small round bulbs, the flesh of which is white and tender. The top is small, consisting of a few long, narrow, or strap-shaped leaves.

5. **EARLY SIX-WEEKS**—syn. Early Dwarf, Early Ball.—Bulbs globular, and growing chiefly above ground. Skin greenish white; flesh white, tender, and of good flavour. Very early, and only adapted for use in a young state, in summer and autumn.

6. **WHITE STONE**.—Bulbs round, somewhat flattened, larger than those of the Early White Dutch. Skin white, tinged with green; flesh white, of fine quality, and firmer than that of the Early White Dutch. It is well adapted for late sowings, and is soon fit for use; but when sown in spring it is apt to run quickly to seed.

7. **VERTUS**—syn. French Tender, Navet tendre des Vertus.—Oblong; flesh very white, and of good quality. In this country, however, the round form is generally preferred to the oblong.

8. **RED AMERICAN STONE**.—Bulb small, oblate, growing chiefly above ground. Skin violet, where exposed to the light, white elsewhere; flesh white and tender, but not so sweet as that of many other sorts.

9. **CHIVAS' ORANGE JELLY**.—A Cheshire variety of a handsome round form, with a small top. The skin is pale orange, the flesh yellow, juicy, sweet, and tender. It has very little fibre, so that when boiled it almost acquires the consistence of a jelly.

10. **YELLOW MALTA**—syn. Maltese, Yellow Maltese, Golden Maltese.—Bulbs about 2 inches in diameter, round, flattened above, and rather concave below, with a small tap-root proceeding from the centre of the hollow. Flesh yellow and tender. An excellent sort.

11. **YELLOW FINLAND**—syn. Early Finland, Navet jaune de Finlande.—Bulb small, round above, concave below, with a very small tap-root. Top small. Skin smooth and yellow; flesh yellow and very sweet. An excellent sort, which keeps long and is somewhat earlier than the Yellow Malta, to which it bears considerable resemblance. It should be sown in June and July.

12. **SCOTCH YELLOW**—syn. Aberdeen Yellow.—Bulb small, or middle-sized, roundish, grow-

ing about half above ground. Skin yellow; flesh yellow, firm, and very sweet. An exceedingly hardy sort, standing a severe winter better than any other garden variety. In the south, it should be sown for winter use about the middle of July; and in the north, in the beginning of that month.

13. **TELLOW**—syn. Teltau Navet petit de Berlin, Markische Teltower.—Very small, with a tapering root, and a top not larger than that of a radish. The flesh is firm, very hot, but the rind is more especially so; this part, however, is not peeled off, as in it the piquant flavour is principally contained. It is employed in ragouts, and for seasoning in various ways. It should be sown in light sandy soil. In rich ground its flavour is deteriorated. In the neighbourhood of Teltow, in Brandenburg, it is sown in April, and again in August; but for the second sowing in this country, July is late enough.

Soil and Manure.—The turnip succeeds best in light sandy soils, and loams containing a large proportion of sand. Stiff retentive soils, on the contrary, are ill adapted for the growth of good crops of well-flavoured bulbs, and on such, also, early crops are more apt to run to seed. In light dry soils, well-decomposed farm-yard dung is one of the best applications that can be made, as it not only affords nourishment but moisture to start the young plants into the rough leaf. For heavy land, littery dung, not much decomposed, may be advantageously employed. Bone-dust, superphosphate of lime, or guano, applied either separately or together with farm-yard manure, exercise a highly beneficial effect on the turnip crop, especially in old garden soils containing an excess of organic matter, forcing the plants into the rough leaf, and encouraging the development of the bulbs.

Culture.—Turnips are usually sown broadcast in gardens; and as they are not required to be grown to a large size, this mode answers very well in light soils. Where the soil, however, is more tenacious than could be wished for this crop, it is a good plan to draw drills with a hoe at about 15 inches apart, fill them with well-rotted manure, which may be watered with guano-water, and then cover with about 2 inches of soil. Ridges will thus be formed, and their tops should be levelled by passing a light roller along them. A small grove ought next to be opened along the centre of the ridges, and in it the seeds should be

sown as regularly as possible, then slightly covered with fine soil, which should afterwards be rolled. By this mode the plants will receive abundance of nourishment from the manure immediately below them, as soon as they require it; at the same time, whether the weather prove dry or wet, the soil in the ridge, although naturally tenacious, will always be looser than the same kind of soil laid flat.

The times and frequency of the sowings depends on whether very young turnips are much in request or not. If such be the case, some of the Early White Dutch may be sown in a warm border in the end of January or in February, and protected. A larger sowing should be made in March, two sowings in April. In May, one sowing will suffice; but it would be advisable that part of it should be made in a cool situation; also that two or three varieties should be employed, for it often happens that one sort succeeds, whilst another fails. The risk of failure is greatly decreased, however, by employing two or more varieties. The principal autumn and winter crops should, in northern and cold districts, be sown in the last week of June; and in southern parts of the kingdom, in the first fortnight of July. A small sowing may be made in the first or second week of August, and even in the last week of that month, for supplying young turnips occasionally in winter, and for standing later in spring than the main crop. In most situations, a sowing once a-month, from March to July inclusive, will be sufficient, especially if, from experience, the most suitable varieties can be chosen.

After sowing, the first attention should be directed to the protection of the plants from the ravages of the flea. In some states of the weather this is very difficult, and the whole sowing may either be destroyed, or the plants be so crippled that they never recover, nor form a succulent bulb. Just before the plants make their appearance, the ground should be well moistened, if the weather is dry; and when the seed-leaves appear, the whole of the ground should be dusted over with lime. A very light frame-work mounted on wheels, and covered with canvas, daubed with tar or other sticky substance, has been employed with considerable success in catching the flea. Several persons may drive the flea from a quarter of young turnips as follows:—In the first place, let a supply of water

be brought close to hand, or say to each end of the quarter; then let one person move steadily along one side of the piece of ground from one end to the other, delivering the water through a rose as he proceeds. The fleas will jump forward as the water approaches them; and a second person following the first will keep them on the hop forward; whilst a third will drive them still further, and so on till the whole are driven off the ground. This process occasionally repeated, will permit the plants to acquire their rough leaves, and the crop, which would otherwise have been destroyed, or greatly injured, will probably be saved. The subsequent culture essentially consists in watering, thinning, and keeping the ground stirred and free from weeds. A moist season, or one in which warm cloudy weather prevails, is most suitable for turnips. In continued dry weather, the growth of the plants is checked, and although genial weather should ensue, and start them into an over-growth, still the bulbs are never so tender and succulent as if growth had taken place at a uniform rate. Watering should therefore be attended to in dry weather. Cold spring water must not, however, be used, as such would tend to check the growth, in hot weather more especially. The soil, by means of moistening and stirring, should be kept as loose as possible, and, as a matter of course, free of weeds. Partial thinning should be commenced as soon as the plants are fairly above ground, or at all events, as soon as they have acquired their first rough leaves. The distance left between the plants must be regulated according to the size of the variety. In rows, or drills, the small sorts may be left at 4 inches apart, and the larger at 5 or 6 inches. In broadcast sowings, 6 inches may be allowed each way for summer crops, and 8 inches for those intended to stand the winter.

Taking and Storing the Crop.—Crops for summer and autumn use are, of course, drawn as soon as they become fit for use—the largest bulbs being taken first. With respect to the crops for winter supply, the greater portion may generally be left in the ground to be taken up as wanted; but a small quantity of bulbs should be taken up, topped, tailed, and stored in sand for use in frosty weather. In cold situations, if the more tender sorts are grown, it is advisable to take up the whole crop, and store it in ridges like potatoes; and

the same precautions should be taken to secure it from frost and damp. The tops should be removed; but the roots or tails should be left, as the bulbs keep better when this is the case.

To save Seed.—It is rather a difficult matter to obtain the seed of turnips true in gardens, on account of the tendency which all plants of the brassica tribe have to cross with one another. For this reason, no other plant of that genus should be allowed to flower at the same time in the neighbourhood of the sort, the seed of which is to be saved. Only the best formed bulbs ought to be selected for bearing seed; and they should be taken up in autumn, and planted 2 feet apart in an open situation. When the seed is perfectly ripe, it may be beaten out, and, after having been well dried, hung up in a canvas bag in a cool, dry, airy place. It preserves its germinative power for four or five years, and sometimes longer.

Insects and Diseases.—"Turnips often fall a sacrifice to the inroads of insects; indeed, this invaluable vegetable is attacked by a greater variety of species than probably any other crop. At first, the *ants* run off with vast numbers of the seeds; and no sooner have the seed-leaves appeared above ground than the flea, fly, or beetle (*Altica nemorum*), alights upon the field to devour the succulent leaves; and the plant dies. The allied species, named *Altica consobrina*, *obscura*, and *concinna*, as well as a weevil (*Ceutorhynchus contractus*), assist in defoliating the turnips. At a more advanced stage of growth, the nigger caterpillars, the offspring of *Athalia spinarum*, make skeletons of the foliage, which is also an acceptable food to the caterpillars of the white butterflies (*Pontia brassicæ*, *napi*, and *rapæ*), the white diamond-back moth (*Ceratomyia xylostella*, *Chrysomela* or *Phædon betulæ*), and the Y-moth (*Plusia gamma*); whilst the fields swarm with voracious slugs and snails. The green leaves are mined by the larvæ of flies named *Phytomyza nigricornis* and *Drosophila flava*; and in the autumn they are deprived of all nourishment by the plant-lice (*Aphis brassicæ* and *rapæ*). The seed crops are diminished by the *Aphis floris-rapæ*, the rose-chaffer (*Cetonia aurita*), and a minute beetle (*Meligethes ceneus*); and the seeds are not secure in their pods from the larvæ of a weevil (*Ceutorhynchus assimilis*). Another species (*C. pleurostigmus*), causes galls upon the bulbs, which are eroded and injured by the surface-grubs, produced by the moths

named *Agrotis segetum* and *exclamationis*, and *Triphaena pronuba*, as well as by the maggots of flies (*Anthomyia gnava* and *radicum*); whilst wireworms from the click-beetles (*Agriotes obscurus*, *lineatus*, and *sputator*, and possibly *Athous ruficaudis*), snake-millipedes (*Julus terrestris* and *pulchellus*, with *Polydesmus complanatus*), centipedes, and scolopendræ, complete their destruction, leaving the decomposing bulbs to generate rove-beetles (*Oxytelus rugosus* and *sculpturatus*), the winter-gnat (*Trichocera hiemalis*), and a minute fly (*Sciara fucata*), whose larvæ live in putrid vegetable substances.

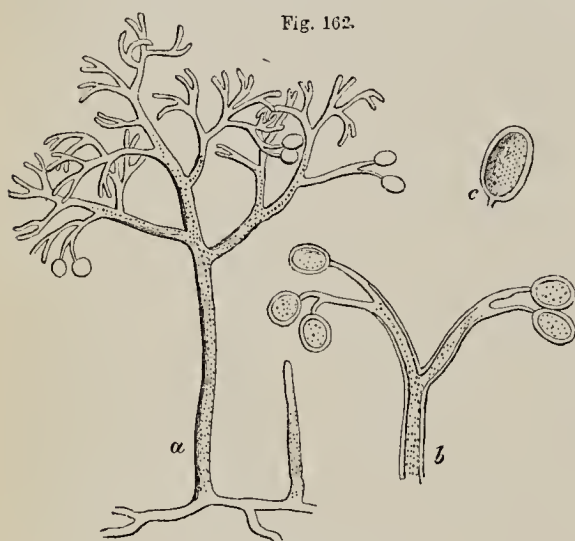
"Numbers of parasitic insects accompany these pests to keep them down; whilst rooks, starlings, gulls, lapwings, pheasants, partridges, and a number of smaller birds, live at certain periods entirely upon them."

The remedies proposed to destroy the turnip insects are very numerous, and can only be alluded to here. Burning, hoeing, and rolling are recommended to banish the turnip beetle or fly. Drawing nets and painted boards over the ground will reduce their numbers; and dusting the young crops with powdered lime will drive away the beetles, and tend to recover the crop. The black caterpillar or nigger is best got rid of by ducks and poultry; but drawing a cart-rope, a bushed hurdle, or green furze over the rows, will wound and kill large quantities, and those which are moulting at the time must die. Hand-picking is not to be neglected. The plant-lice can only be checked by cutting off the infested leaves and burning them. Lime-dust, also lime and tobacco-water, will kill them. The other caterpillars defoliating the leaves, as well as those at the roots, together with the wireworms, can only be conquered by persevering in hand-picking.—(Curtis, in *Morton's Cyclopaedia of Agriculture*).

The principal disease by which turnips are liable to be attacked, is that known as *anbury*, or *fingers-and-toes*, in which the roots become forked or fingered, and ultimately rot. The anbury has been attributed to the agency of insects, but these are now generally considered to be a consequence, and not the cause of the malformation—the rotting mass merely affording them a suitable place in which to deposit their eggs, and the larvæ produced from these assist in completing the destruction of the root. The disease occurs most frequently in ill-drained land, old garden ground, black or moory soils, and in such as have been worn

out by turnip crops following each other too closely. The application of lime, bone-dust, and other manures of a calcareous nature, has been attended with some success in soils where anbury is frequent; and its recurrence is likewise wholly or partially prevented by allowing several years to elapse before the ground is again cropped with turnips. The true cause of the disease is not as yet fully understood; but it appears to us that anbury is to be ascribed to a deficient supply of one or more of the inorganic constituents of the food of the plant.

Where too much manure has been given, the leaves of turnips are sometimes attacked by a fungus called *Botrytis parasitica* (Fig. 162). A species of oidium also makes its ap-



BOTRYTIS PARASITICA.

a, Plant with mycelium magnified. b, Extremity of branch with spores more highly magnified. c, Separate spore.

pearance upon the leaves, particularly when the plants have been suffering from a deficient supply of moisture. In both cases, more or less injury to the crop of roots is the result.

VALERIANA, CORNUCOPIÆ, L. (Triandria Monogynia, L.; Valerianæ, D. C.; Valerianaceæ, Lind.)—This pretty annual, a native of Barbary, is said to furnish an excellent salad, superior to corn salad. We are not aware whether the plant has as yet been grown for this purpose in Britain; but it appears to be worthy of a trial. It should be sown on a light warm border; and by successive sowings from April till the end of July, a supply may be obtained throughout the summer and autumn.

WOOD SORREL (*Oxalis Acetosella*, L.—Decandria Pentagynia, L.; Oxalideæ, D. C.; Oxalidaceæ, Lind.) is a hardy perennial, a native of Britain, where it grows wild in woods.

The leaves are occasionally used in salads, to which they are by many considered to be a grateful addition. In common with other plants of the same natural order, they contain a considerable amount of oxalic acid. This plant is seldom cultivated in gardens; but if required, a few plants may be transplanted in spring from the places where they naturally grow, into a moist shady border, the soil of which should be mixed with leaf-mould. By cutting over the plants in April or May, before they come into flower, a fresh growth of young leaves will be induced, and the trouble arising from seed being shed will be prevented.

WORMWOOD (*Artemisia*, L.—Syngenesia Polygamia Superflua, L.; Compositæ, D. C.; Asteraceæ, Lind.)

Of this three species are cultivated:—

1. COMMON WORMWOOD (*A. Absinthium*, L.), a native of Britain.
2. ROMAN WORMWOOD (*A. pontica*, L.), a native of Austria and Hungary.
3. SEA WORMWOOD (*A. maritima*, L.), a native of Britain.

They are all hardy perennials, aromatic, and intensely bitter. An infusion of the leaves and tops is used as a vermifuge, tonic, and stomachic; and the leaves are found to be beneficial to poultry. The second sort, not being so nauseous as the others, is the one generally preferred.

Wormwood grows well in any soil, but is most aromatic when planted in a poor and rather dry soil, with a warm aspect. The common sort may easily be raised from seed sown in spring, but both this and the other kinds are generally propagated by dividing the plants in spring, or by cuttings. It may be planted 1 foot apart in rows 15 inches asunder, and will stand for many years in the same place, no other culture being required than to hoe the ground occasionally. Some shoots may be cut when coming into flower, and dried for winter use.

CHAPTER XI.

CROPPING THE KITCHEN GARDEN.

It is a well-known fact, that the same kind of crop cannot be successfully grown on the same ground for several consecutive years. A striking instance of this is found in agricul-

ture. Farmers know that if land be too frequently cropped with clover, it becomes what is termed *clover-sick*, and refuses to produce that crop till a considerable space of time has elapsed. So much is this the case, that in some districts two rotations intervene before the ground is again sown with clover.

Various theories have been formed as to the causes which render the rotation or alternation of crops necessary. De Candolle, supported by the experiments of Brugmans and Macaire, supposed that the roots had the power of excreting or throwing off substances unnecessary, or injurious to the plants to which they belong. Hence, it was concluded that the soil eventually became poisoned by the excrementitious matters of the plants grown on it, and was in consequence rendered unfit for the growth of plants of the same kind until these substances were decomposed. The experiments upon which these conclusions were founded having been considered inconclusive, others were undertaken, and from them it has been found that excretion from the roots only takes place when these are wounded. This theory has therefore fallen to the ground.

The next theory which claims attention is founded on the exhaustion of the mineral substances contained in the soil. It has already been shown, that inorganic substances are essential to the growth of plants, and that without mineral food plants cannot live. It has also been shown that these substances are obtained from the soil. If, then, they are not present in sufficient quantity, or do not exist in such a state that they can be taken up by the roots, it is evident that the plant must suffer in consequence. It cannot be denied, that by the successive removal of crops of the same nature from the soil, the amount of mineral substances contained in it, in a state available for the food of plants, is decreased.

Now, it is known that some plants contain a greater amount of certain mineral substances than others; for instance, some plants require much potash or soda, others much phosphoric acid, some much lime, others a large quantity of silica. This being the case, it is evident that it would be beneficial to cause one crop requiring only a small quantity of any particular inorganic substance, to succeed another requiring that substance in large amount. Such is the explanation of the beneficial results attendant on the rotation of crops given by this theory—a theory which, though more satis-

factory than the preceding, is still far from being conclusive, inasmuch as in practice results at variance with its conclusions are obtained. Crops requiring a large amount of a certain mineral substance, are found to succeed well after other crops requiring the same article in nearly equal quantities. Moreover, experience tells us, that by merely restoring the inorganic matters abstracted from the soil by any crop, we do not fit it for the immediate production of other crops of the same kind, and that the same will be the case even if the inorganic constituents be returned in much greater quantity, and in such a state that they can be readily taken up by the roots of plants. The part which those important constituents of the food of plants, the carbonic acid and ammonia contained in the soil, may have in the beneficial effects of a proper rotation, appears to have been underrated. May not the exhaustion of these substances, likewise, and not solely that of the inorganic food, be the true cause of the necessity of a rotation of crops? On this basis the contradictory results previously referred to might be easily explained.

The necessity of a change of crops, whatever be the cause, being evident, it remains to point out what are the general rules which are found the best in practice. These are as follows:—

1. Plants of the same natural order should not succeed each other.
2. Crops which occupy the ground for several years should be succeeded by others of short duration; thus asparagus or strawberries may be followed by cabbages or lettuces.
3. Plants grown for their roots or bulbs should not be succeeded by others grown for the same purpose; neither should plants grown for their seeds follow each other.

The above rules apply to all systems of rotation, but it is impossible to recommend any particular course of cropping as the best, for this must entirely depend upon the richness of the soil, the amount of manure at command, the size of the garden, the products required, and the relative proportion of each. The market gardeners round London, who may justly be considered our best kitchen gardeners, adopt no particular system of rotation. They *manure highly, trench frequently, and plant any crop that is fit for planting out when the ground becomes vacant*. In doing so, however, they follow, as much as possible, the rules just given.

Two modes of cropping are adopted in gardens. The first may be termed separate cropping, the second simultaneous cropping. In the former, the ground is only occupied by one crop at a time; in the latter, by several. For instance, summer spinach may be sown between the rows of pease and beans, radishes along with carrots, or lettuces together with onions, or planted between the rows of celery, &c.

With regard to the comparative merits of these two modes of cropping, there is much difference of opinion. The finest productions are undoubtedly obtained by the separate system; whilst a greater weight of produce of all sorts, but generally of inferior quality, is obtained by the simultaneous mode. To carry out the latter properly, the soil must be rich and frequently manured; whilst by the other mode, good vegetables may be grown without so much artificial enrichment. Upon the whole, we consider that the separate mode of cultivation is the best adapted for large gardens; that simultaneous cropping may be advantageously adopted in those of small extent; and that in gardens of medium size, from which a great variety of productions are required in considerable quantity, both systems may, to a certain extent, be combined. Thus, succession crops of spinach, lettuce, likewise coleworts and borecole, may occupy the ground between other crops.

It is impossible to detail systems of cropping that would be applicable in all cases. Circumstances render the demand for any particular article exceedingly variable, so that no exact limit can be assigned to the quantity of ground necessary to be allotted to each. Again, the garden may be large enough to admit of several quarters being cropped with potatoes; and in that case it would be proper to direct that the crops of coleworts and cabbages should be planted where the potato crop has been cleared. But, should the garden be small, so as to render it advisable to grow only a few early potatoes on some of the borders, other places must be found for the cabbage crops above mentioned.

Although directions cannot be given to meet all circumstances, yet it may be useful to point out such crops as may not inappropriately follow each other, either in the same season or in the one next ensuing. In the following observations the principal crops are brought under notice; and in most cases an ample choice will be found, so that either as regards crop-

ping the ground, or producing successional supplies, no great difficulty need be experienced.

BEANS may follow borecole, broccoli, cabbages, parsnips, carrots, or potatoes; between the rows may be planted borecole, or Brussels sprouts. Beans may be succeeded by celery, leeks, lettuce, turnips, and any of the cabbage tribe, especially when the ground in the previous year has not been cropped with any of these.

BEET may follow the cabbage tribe, and any other crop, except spinach, turnips, parsnips, carrots, salsafy, and scorzonera. Between the rows, nothing. May be succeeded by pease, beans, cabbages, cauliflowers, lettuces, or any other spring-sown crop, except spinach, turnips, parsnips, and carrots.

BORECOLE may follow pease, beans, lettuces, and potatoes. Between the rows, beans. May be succeeded in the following spring by pease, beans, beet, carrots, parsnips, onions, potatoes, kidney-beans, or any but cruciferous plants.

BROCCOLI may follow, in the same season, pease, beans, or kidney-beans. Between the rows, nothing. May be succeeded by any crop requiring to be sown or planted when it is cleared off, cruciferous plants excepted.

BRUSSELS SPROUTS. Same as *Borecole*.

CABBAGES may follow, in the same season, pease, beans, kidney-beans, potatoes, lettuces, onions, and any other crop not belonging to the same natural order as themselves. Between the rows, coleworts. May be followed by pease, beans, kidney-beans, potatoes, lettuces, carrots, parsnips, beet, salsafy, scorzonera, celery, or any but cruciferous plants.

CARROTS may follow any but root crops and umbelliferous plants, as parsnips, celery, and parsley. Between the rows, nothing. May be succeeded by any except root crops and plants of its own natural order.

CAULIFLOWERS may follow pease, beans, potatoes, celery, kidney-beans, onions, carrots, lettuces, beet. Between the rows, lettuces, spinach, endive. May be succeeded by any of the preceding.

CELERY may follow any crop which may be cleared off the ground, except, perhaps, parsnips, carrots, parsley; but even as regards these, it is not of much consequence, as the celery is chiefly dependent for nourishment on the manure introduced in the trenches. Between the rows, lettuces may be planted. May be succeeded by pease, beans, kidney-beans, potatoes, turnips, or any of the cabbage tribe.

ENDIVE may follow potatoes, pease, beans, the brassica tribe; but not lettuces, scorzonera, or other compositæ; and with these exceptions, may be succeeded by any crop suitable for borders or other situations where endive is grown.

KIDNEY-BEANS. The same as *Pease*.

LEeks may follow any crop but onions, garlic, shallots, rocambole, or chives.

LETTUCES may follow pease, beans, potatoes, the brassica tribe, and any other crop with the exception of endive, chicory, salsafy, scorzonera, artichoke, cardoon, and other compositæ.

ONIONS may follow the brassica tribe, celery, potatoes, pease, beans, kidney-beans, and even onions, where the ground has been highly enriched by suitable manure, and where the produce is obtained free from canker. May be succeeded by cabbages or coleworts.

PARSNIPS may follow any crop except carrots, celery, parsley, or other umbelliferous plants, and beet, potatoes, salsafy, and scorzonera; and, with these exceptions, may be succeeded by any crop.

PEASE may follow potatoes, carrots, parsnips, turnips, broccoli, or any brassicaceous plants. Exception need only be made to the plants of the same order, such as beans, kidney-beans, or scarlet runners. Between the rows may be sown radishes or summer spinach. Borecole, or Brussels sprouts, may be planted between the rows of dwarf sorts; and if wide enough apart, other crops may be sown or planted in the intermediate spaces. They may be succeeded by broccoli, cabbages, spinach, turnips, late celery, &c.

POTATOES may follow any crop except carrots, parsnips, beet, salsafy, or scorzonera. Between the rows, Brussels sprouts, borecole, or broccoli may be planted; or late celery, if certain rows are left somewhat wider than usual to admit of a trench being dug between them. They may be succeeded by any crop requiring a loose, clean, well-worked soil.

SEA-KALE may follow potatoes, or any species of an annual or biennial nature, except cruciferae. May be succeeded by potatoes, pease, beans, and others not included in the above exceptions.

SHALLOTS may follow pease, beans, potatoes, cabbages, and the like, also, lettuce, endive, spinach. May be succeeded by any crop not of an alliaceous nature.

SPINACH may follow pease, beans, kidney-beans, cabbage, cauliflower, lettuce, or any

other crop, beet excepted. Winter spinach may be succeeded by any spring crop, spinaceous plants excepted.

TURNIPS may follow potatoes, spinach, pease, beans, lettuce, or any other crop not consisting of cruciferous plants; and, with the above exception, may be succeeded by any crop.

It may happen that some crops may have to be sown or planted not in accordance with the above observations, in other words, a crop may have to follow another of the same nature; such may be the case owing to limited space, or a backward season may render certain crops too late for being gathered in proper time for allowing the ground to be occupied by the usual succession. But when this is the case, the ground should either be trenched or dug two spades deep, and manured.

Quantities of Seed required for cropping the Kitchen Garden.—A correct seed estimate can only be made from experience of the relative amount of each kind of vegetable required. The extent of ground to be cropped may be taken into consideration, in connection with the greater or less demand for certain articles. In some families, certain kinds of vegetables are in great demand, even to the total exclusion of various others. The estimate must be framed accordingly. The following quantities have been calculated as an approximation to the quantity of seed generally required to crop an acre. According to circumstances they may be found too little in some instances, somewhat in excess in others. A few deficiencies may easily be made up in good time; whilst a slight excess is, in most cases, desirable, and even advantageous. Many kinds of seeds keep good for several years, and of these it is well to have a surplus; for if they prove true to their variety, a sowing can be made in the following season that can be depended on.

The quantity of seeds required, in general, to crop an acre of garden, may be estimated as follows:—

Pease,.....	24 qts.	Cress,.....	1 lb.
Beans,.....	10 qts.	Endive,.....	3 oz.
Kidney-beans,.....	6 qts.	Leek,.....	1 oz.
Scarlet runners,.....	2 qts.	Lettuce,.....	4 oz.
Borecole,.....	2 oz.	Mustard,.....	1 lb.
Brussels sprouts,....	2 oz.	Onion,.....	12 oz.
Broccoli,.....	6 oz.	Parsley,.....	4 oz.
Cabbage,.....	8 oz.	Parsnip,.....	4 oz.
Red cabbage,.....	1 oz.	Radish,.....	2 qts.
Savoy,.....	3 oz.	Spinach (summer),	3 qts.
Cauliflower,.....	3 oz.	„ (winter),...	2 qts.
Beet,.....	3 oz.	Salsafy,.....	2 oz.
Carrot,.....	8 oz.	Scorzonera,.....	2 oz.
Celery,.....	2 oz.	Turnips,.....	8 oz.

NAMES OF CULINARY VEGETABLES IN ENGLISH, FRENCH, AND GERMAN.

German names are arranged in alphabetical order in the following tables, so that if any vegetable is mentioned, its name in any of these languages can be immediately found, instead of having to search over many pages, which would be the case if the foreign names were only given when treating of the article :—

ENGLISH.	FRENCH.	GERMAN.	ENGLISH.	FRENCH.	GERMAN.
Alexanders.	Maceron.	Smyrnerkraut.	Chicory.	Chicorée sauvage.	Cichorie.
Angelica.	Angélique.	Angelika, Engelwürtz.	Chive.	Ciboulette, Cive, Civette, Appétit.	Schnittlauch.
Anise.	Anis, Boucage.	Anis.	Clary.	Orvale.	Scharlachkraut, Scharlach-Salbei.
Artichoke.	Artichaut.	Artischocke.	Coriander.	Coriandre.	Coriander, Koriander.
Asparagus.	Asperge.	Spargel.	Corn Salad.	Mâche, Doucette, Blanchette, Boursotte.	Ackersalat, Feldsalat, Rabinschen.
Balm.	Méliste, Citronnelle.	Citronenmelisse, Melisse.	Costmary.	Menthe-coq, Tanaïsie-baume.	Frauenmünze, Frauensalbei.
Basil.	Basilic.	Basilikum.	Cress, American.	Cresson d'Amérique.	Amerikanische Kresse.
Bean.	Fève de marais.	Puffbohne, Grosse Bohne.	Cress, Common.	Cresson alénois.	Gartenkresse.
Beet, Leaf.	Bette, Poirée.	Mangold-Kraut.	Cress, Water.	Cresson de fontaine.	Brunnenkresse.
Beet-root.	Betterave.	Borggold-Kraut.	Cucumber.	Concombre.	Gurke.
Borage.	Bourache.	Mangold, Beete, Rothe Rübe (Red).	Dandelion.	Dent de Lion, Pissenlit.	Löwenzahn.
Borecole.	Chou vert.	Grünkohl, Blätterkohl, Braunkohl.	Dill.	Anet.	Dill.
Broccoli.	Brocoli.	Broccoli, Brockelkohl, Spargelkohl.	Egg Plant.	Mélongène, Aubergine, Mé-rangène, Mayenne.	Eierpflanze.
Brussels Sprouts.	Chou de Bruxelles or à jets.	Sprossenkohl, Brüsseler Kohl, Brüsseler Sprossen, Rosenkohl.	Elecampane.	Chicorée blanche or frisée.	} Endivie.
Buckshorn Plantain.	Corne de Cerf.	Krähenfuss.	Endive.	Scarole.	
Burnet.	Pimprenelle, Petite Pimprenelle.	Pimprenell, Pimpinelle.	Endive, Batavian.	Fenouil.	Fenchel.
Cabbage.	Chou cabus, Chou pommé.	Kopfkohl.	Fennel.	Ail.	Knoblauch.
Capsicum.	Piment.	Spanischer Pfeffer.	Garlic.	Courge, Potiron.	Kürbis.
Caraway.	Carvi.	Kümmel.	Gourd.	Houblon.	Hopfen.
Cardoon.	Cardon.	Cardy, Kardone.	Hop.	Marrube blanc.	Andorn.
Carrot.	Carotte.	Möhre, Carotte.	Horehound.	Raifort sauvage, Grand Raifort, Cranson rustique.	Meerrettig.
Cauliflower.	Chou-fleur.	Blumenkohl.	Horse-radish.	Hyssop.	Isop.
Celeriac.	Céleri-rave.	Knollensellerie.			
Celery.	Céleri.	Sellerie.			
Chamomile.	Camomille.	Kamille.			
Chervil.	Cerfeuil.	Kerbel, Körbel.			

ENGLISH.	FRENCH.	GERMAN.	ENGLISH.	FRENCH.	GERMAN.
Jerusalem Artichoke.	Topinambour, Poire de terre.	Erd-äpfel.	Rape.	Navette.	Repskohl.
Kidney-bean.	Haricot.	Schminkbohne.	Rhubarb.	Rhubarbe.	Rhabarber.
Lavender	Lavande.	Lavendel, Spicke.	Rocambole.	Ail d'Espagne.	Rockambole, Rockenbollen, Rocambollen, Schlangenknolauch.
Leek.	Poireau, Porreau.	Lauch.	Rosemary.	Romarin.	Rosmarin.
Lentil.	Lentille.	Linse.	Rue.	Rue.	Raute, Weinraute.
Lettuce.	Laitue.	Salat, Lattich.	Sage.	Sauge.	Salbei, Salbey.
Liquorice.	Régliſſe.	Süßholz.	Salsafy.	Salsifs, Cercifs.	Haferwurz.
Marigold.	Souci des jardins.	Ringelblüth.	Samphire.	Perce-pierre, Herbe Saint-Pierre, Bacile, Crête marine, Criste marine.	Meerfenchel, Seefenchel.
Marjoram.	Marjolaine.	Marjoran.	Savory.	Sariette, Savorés, Savourés.	Bohnenkraut, Pfefferkraut, Köll.
Mint.	Menthe.	Münze.	Savoy.	Chou de Milan, Chou pommé frisé.	Savoyerkohl, Wirsing, Wirsing.
Mint, Pennyroyal.	Potliot.	Poleimünze.	Scorzonerä.	Scorzonère, Salsifs d'Espagne, Salsifs noir.	Scorzonere, Scorzonerwurz, Schwarzwurz.
Mint, Pepper.	Menthe poivrée.	Pfeffermünze.	Scurvy Grass.	Cochlearia, Herbe aux cuillers.	Löffelkraut.
Morel.	Morille.	Morehel.	Sea-kale.	Chou marin.	Meerkohl, Seekohl.
Mushroom.	Champignon.	Champignon, Essbare Blätter-schämme.	Shallot.	Echalote.	Schalotten.
Mustard.	Moutarde.	Senf.	Skirret.	Chervis, Chirouis, Cherui, Giroles.	Zuckerwurz, Zuckermerk.
Nasturtium.	Capucine.	Kapuzinerblume, Kapuzinerkresse, Indianische Kresse.	Sorrel.	Oseille.	Sauerampfer.
New Zealand Spinach.	Tetragone étalée or cornue.	Neuseelandischer Spinat.	Spinach.	Épinard.	Spinat.
Onion.	Oignon.	Zwiebel, Zipolle.	Tansy.	Tanaïſie.	Rheinfahrn.
Orach.	Arroche, Belle Dame, Bonne Dame.	Gartenmelde, Melde.	Tarragon.	Estragon.	Estragon, Dragun.
Parsley.	Persil.	Petersilie.	Thyme.	Thym.	Thymian.
Parsnip.	Pauais.	Pastinak.	Tobacco.	Tabac.	Tabak.
Patience.	Oseille-épinard, Patience, Épinards immortels.	Englische Spinat, Winter-Spinat.	Tomato.	Tomate, Pomme d'Amour.	Liebesäpfel.
Pea.	Pois.	Erbse.	Tree Primrose.	Jambon des jardiniers.	Rapontica, Rapuntica, Rapunzel Sallery.
Potato.	Pomme de terre.	Kartoffel.	Truffle.	Truffe.	Trüffel.
Purslane.	Pourpier.	Portulak.	Turnip.	Navet.	Rübe.
Radish.	Rave.	} Radies, Rettig.	Wood Sorrel.	Alleluia, Surelle, Petite Oseille.	Sauerklee.
Radish, Turnip-rooted.	Radis.		Wormwood.	Absinthe.	Wermuth.
Rampion.	Raiponce.				

FRENCH.	ENGLISH.	FRENCH.	ENGLISH.	FRENCH.	ENGLISH.
Absinthe.	Wormwood.	Cranson.	Horse-radish.	Onagre.	Tree Primrose.
Ail.	Garlic.	Cranson rustique.	Horse-radish.	Orvale.	Clary.
Ail d'Espagne.	Rocambole.	Cresson alénois.	Common Cress.	Oseille.	Sorrel.
Alleluia.	Wood Sorrel.	Cresson d'Ame- rique.	American Cress.	Oseille-épinard.	Patience.
Anet.	Dill.	Cresson de fontaine.	Water Cress.	Panais.	Parsnip.
Angélique.	Angelica.	Crête marine.	Samphire.	Patience.	Patience.
Anis.	Anise.	Criste marine.	Samphire.	Persil.	Parsley.
Appétit.	Chive.			Perce-pierre.	Samphire.
Arroche.	Orach.	Dent de Lion.	Dandelion.	Petite Oseille.	Wood Sorrel.
Artichaut.	Artichoke.	Doucette.	Corn Salad.	Petite Pimpre- nelle.	Burnet.
Asperge.	Asparagus.			Piment.	Capsicum.
Aubergine.	Egg-Plant.	Echalote.	Shallot.	Pimprenelle.	Burnet.
Aunée.	Elecampane.	Épinard.	Spinach.	Pissenlit.	Dandelion.
		Épinards immor- tels.	Patience.	Poire de terre.	Jerusalem Arti- choke.
Bacile.	Samphire.	Estragon.	Tarragon.	Poireau.	Leek.
Basilic.	Basil.			Poirée.	Leaf-beet.
Belle Dame.	Orach.	Fenouil.	Fennel.	Pois.	Pea.
Bette.	Leaf-beet.	Fève de marais.	Bean.	Potiron.	Gourd.
Betterave.	Beet-root.			Pomme d'Amour.	Tomato.
Blanchette.	Corn Salad.	Giroles.	Skirret.	Pomme de terre.	Potato.
Bonne Dame.	Orach.	Grand Raifort.	Horse-radish.	Porreau.	Leek.
Boucage.	Aniseed.	Grosse Lentille.	Lentil.	Pouliot.	Pennyroyal Mint.
Bourrache.	Borage.			Pourpier.	Purslane.
Boursette.	Corn Salad.	Haricot.	Kidney-bean.		
Brocoli.	Broccoli.	Herbe aux euillers.	Scurvy Grass.	Radis.	Radish (Turnip- rooted).
		Herbe Saint- Pierre.	Samphire.	Raifort sauvage.	Horse-radish.
Camomille.	Chamomile.	Houblon.	Hop.	Raiponce.	Rampion.
Capucine.	Nasturtium.	Hyssope.	Hyssop.	Rave.	Radish.
Cardon.	Cardoon.			Régliſſe.	Liquorice.
Carotte.	Carrot.	Jambon des jar- diniers.	Tree Primrose.	Rhubarbe.	Rhubarb.
Carvi.	Caraway.			Romarin.	Rosemary.
Céleri.	Celery.	Laitue.	Lettuce.	Rue.	Rue.
Céleri-rave.	Celeriac.	Lavande.	Lavender.		
Cercifis.	Salsafy.	Lentille blonde.	Lentil.	Salsifis.	Salsafy.
Cerfeuil.	Chervil.	Lentille commune.	Lentil.	Salsifis d'Espagne.	Scorzonera.
Champignon.	Mushroom.			Salsifis noir.	Scorzonera.
Cherui.	Skirret.	Macaron.	Alexanders.	Sariette.	Savoy.
Chervis.	Skirret.	Mâche.	Corn Salad.	Sauge.	Sage.
Chicorée blanche.	Endive.	Marjolaine.	Marjoram.	Savorés.	Savory.
Chicorée sauvage.	Chicory.	Marrube blanc.	Horehound.	Savourés.	Savory.
Chirouis.	Skirret.	Mayenne.	Egg Plant.	Scarole.	Batavian Endive.
Chou de Bruxelles.	Brussels Sprouts.	Méliste.	Balm.	Scorsonère.	Scorzonera.
Chou cabus.	Cabbage.	Mélongène.	Egg Plant.	Souci des jardins.	Marigold.
Chou-fleur.	Cauliflower.	Menthe-coq.	Costmary.	Surelle.	Wood Sorrel.
Chou marin.	Sea-kale.	Menthe.	Spear Mint.		
Chou de Milan.	Savoy.	Menthe poivrée.	Peppermint.	Tabac.	Tobacco.
Chou pommé.	Cabbage.	Mérangène.	Egg Plant.	Tanaïsie.	Tansy.
Chou pommé frisé.	Savoy.	Morille.*	Morel.	Tanaïsie-baume.	Costmary.
Chou vert.	Borecole.	Moutarde.	Mustard.	Tétragone étalée or cornue.	New Zealand Spi- nach.
Ciboulette.	Chive.			Thym.	Thyme.
Citronnelle.	Balm.	Navet.	Turnip.	Tomate.	Tomato.
Cive.	Chive.	Navette.	Rape.	Topinambour.	Jerusalem Arti- choke.
Civette.	Chive.			Truffe.	Truffle.
Cochlearia.	Scurvy Grass.	Oignon.	Onion.		
Concombre.	Cucumber.				
Coriandre.	Coriander.				
Corne de Cerf.	Buckshorn Plan- tain.				
Courge.	Gourd.				

* This must not be confounded, as it sometimes is, with the *Morelle*, which is the French name of *Solanum nigrum*, a plant which, if not poisonous, belongs to a very suspicious family.

GERMAN.	ENGLISH.	GERMAN.	ENGLISH.	GERMAN.	ENGLISH.
Ackersalat.	Corn Salad.	Indianische Kresse.	Nasturtium.	Rapunzel.	Rampion.
Alant.	Elecampane.	Isop.	Hyssop.	Rapunzel Sellery.	Tree Primrose.
Amerikauische Kresse.	Americau Cress.			Raute.	Rue.
Andorn.	Horehound.	Kamille.	Chamomile.	Repskohl.	Rape.
Angelika.	Angelica.	Kapuzinerblume.	Nasturtium.	Rettig.	Radish.
Anis.	Anise.	Kapuzinerkresse.	Nasturtium.	Rheinfahrn.	Tansy.
Artischocke.	Artichoke.	Kardone.	Cardoon.	Rhabarber.	Rhubarb.
		Kartoffel.	Potato.	Ringelblume.	Marigold.
		Kerbel.	Chervil.	Rocambollen.	Rocambole.
Basilikum.	Basil.	Knoblauch.	Garlic.	Rockambol.	Rocambole.
Beete.	Beet.	Knollensellerie.	Celeriac.	Rockenbollen.	Rocambole.
Blätterkohl.	Borecole.	Köll.	Savory.	Rosenkohl.	Brussels Sprouts.
Blumenkohl.	Cauliflower.	Kopfkohl.	Cabbage.	Rosmarin.	Rosemary.
Bohnenkraut.	Savory.	Körbel.	Chervil.	Rothe Rübe.	Red Beet.
Boretsch.	Borage.	Koriander.	Coriander.	Rübe.	Turnip.
Borrage.	Borage.	Krühenfuss.	Buckshorn Plantain.		
Braunkohl.	Borecole.			Salat.	Lettuce.
Broccoli.	Broccoli.	Kümmel.	Caraway.	Salbei.	Sage.
Brockelkohl.	Broccoli.	Kürbis.	Gourd.	Sauerampfer.	Sorrel.
Brunnenkresse.	Water Cress.			Sauerklee.	Wood Sorrel.
Brüsseler Kohl.	Brussels Sprouts.	Lattich.	Lettuce.	Savoyerkohl.	Savoy.
Brüsseler Sprossen.	Brussels Sprouts.	Lauch.	Leek.	Schalotten.	Shallot.
		Lavendel.	Lavender.	Scharlachkraut.	Clary.
		Liebesäpfel.	Tomato.	Scharlach-Salbei.	Clary.
Cardy.	Cardoon.	Linse.	Lentil.	Schlangenkno- blau.	Rocambole.
Carotte.	Carrot.	Löffelkraut.	Scurvy Grass.	Schminkbohne.	Kidney-bean.
Champignon.	Mushroom.	Löwenzahn.	Dandelion.	Schnittlauch.	Chive.
Cichorie.	Chicory.			Schwarzwurzel.	Scorzonera.
Citronenmelisse.	Balm.	Mangold.	Beet.	Scorzonere.	Scorzonera.
Coriander.	Coriander.	Mangold-Kraut.	Leaf beet.	Scorzonerwurzel.	Scorzonera.
		Marjoran.	Marjoram.	Seefenchel.	Samphire.
		Meerfenchel.	Samphire.	Seekohl.	Sea-kale.
Dill.	Dill.	Meerkohl.	Sea-kale.	Sellerie.	Celery.
Dragun.	Tarragon.	Meerrettig.	Horse-radish.	Senf.	Mustard.
		Melde.	Orach.	Smyrnerkraut.	Alexanders.
Eierpflanze.	Egg Plant.	Melisse.	Balm.	Spanischer Pfeffer.	Capsicum.
Endivie.	Endive.	Möhre.	Carrot.	Spargel.	Asparagus.
Engelwürtz.	Angelica.	Morchel.	Morel.	Spargelkohl.	Broccoli.
Euglische Spinat.	Patience.	Münze.	Mint.	Spicke.	Lavender.
Erbse.	Pea.			Spinat.	Spinach.
Erdäpfel.	Jerusalem Arti- choke.	Neuseelandischer Spinat.	New Zealand Spinach.	Sprossenkohl.	Brussels Sprouts
Essbare Blätter- schamme.	Mushroom.			Süßholz.	Liquorice.
Estragon.	Tarragon.	Pastinak.	Parsnip.		
		Petersilie.	Parsley.	Tabak.	Tobacco.
Feldsalat.	Corn Salad.	Pfefferkraut.	Savory.	Thymian.	Thyme.
Fenchel.	Fennel.	Pfeffermünze.	Peppermint.	Trüffel.	Truffle.
Frauenmünze.	Costmary.	Pimpernell.	Burnet.		
Frauensalbei.	Costmary.	Pimpinelle.	Burnet.	Weinraute.	Rue.
		Poleimünze.	Pennyroyal Mint.	Wermuth.	Wormwood.
Gartenkresse.	Common Cress.	Porre.	Leek.	Winter-Spinat.	Patience.
Grosse Bohne.	Bean.	Portulak.	Purslane.	Wirsing.	Savoy.
Grünkohl.	Borecole.	Puffbohne.	Bean.	Würsing.	Savoy.
Gurke.	Cucumber.				
		Rabinschen.	Corn Salad.	Zipolle.	Onion.
Haferwurzel.	Salsafy.	Radies.	Radish.	Zuckermerk.	Skirret.
Hopfen.	Hop.	Rapontica.	Tree Primrose.	Zuckerwurzel.	Skirret.
		Rapuntica.	Tree Primrose.	Zwiebel.	Onion.

CHAPTER XII.

PROPAGATION.

Plants are propagated by seeds for new individuals, and by bulbs, tubers, runners, offsets, suckers, slips, layers, cuttings, sometimes by leaves, and by grafting, inarching, and budding, for the multiplication of those individual species or varieties that have been raised from seed.

I.—PROPAGATION BY SEED.

This is the most natural mode, and the one which is common to all plants in their natural state. It is from seed that the most healthy and vigorous plants are produced; and, generally speaking, it is the most advantageous mode of propagation, except where the exact counterpart of a plant is required. In that case, other modes, such as budding, grafting, &c., must be resorted to where practicable. The way in which nature effects the dissemination of plants is worthy of notice; for if carefully observed, useful lessons may be learned from it. Some seeds are round and heavy; but others are furnished with wings, or other light appendages, by which they can be carried to a distance by the wind, so that, instead of a number of new individuals being crowded together in a limited space around the parent plant, to the injury of the latter, as well as of each other, they are scattered far and wide.

In our climate seeds generally ripen in autumn, but in most cases germination does not take place till spring; yet they mostly fall from the plant in autumn; for, were they to hang on, most of them would be injured by being alternately wet and dry, and by exposure to frost. "By an admirable provision of nature," remarks Professor Du Breuil, in his *Cours Élémentaire Théorique et Pratique d'Arboriculture*, "the seeds of our largest trees, as the oak, beech, and chestnut, drop before the fall of the leaves, which then cover them to the depth of some inches. The leaves decay in the course of the winter, and form towards spring a light covering of leaf-mould, highly favourable to vegetation. Small seeds, such as those of the lime and ash, do not begin to drop till after the leaves have commenced to fall, and are thus placed at a less depth." From this it may be concluded, that seeds

have naturally a light covering previous to germination. Although the oak thrives well in strong deep loam, yet, self-sown, the acorns are placed amongst leaf-mould. Hence it may be inferred, that the soil best adapted for the growth of a plant is not always that which should be selected for the seeds to germinate amongst; and it may be adopted as a general rule, that seeds are best sown in a fine, light, rich soil. This, in many cases, cannot be afforded; nevertheless, where seeds must necessarily be sown in the natural soil, the latter should be ameliorated as much as possible by pulverization, and other means. It should be made as fine as possible, unless by so doing there is danger of rendering the surface too compact and crusted. This is apt to be the case when aluminous soils, after having been reduced to a fine powder, are soaked and beaten by rains, and afterwards baked by heat and drought. They then form a uniformly compact crust, through which the tender plumule cannot readily make its way, and when it does appear above the surface, it has a crippled appearance. From what has been stated, in accordance with what is observed in nature, and from experience, it may be laid down as a general principle, that seeds should be sown in rich soil, easily permeable to the young roots as well as to the plumule. Also, that whilst large seeds should not be buried much below the surface, small seeds ought to be sown very shallow, in fact, merely covered, say one-tenth of an inch deep, and that the depth of covering should be increased somewhat in proportion to the size of the seeds. Those of the bean and oak may be 2 inches deep, the walnut and chestnut 3 inches.

For successful propagation by seeds, several conditions are necessary—1st. That the seeds have been perfectly ripened; 2d. That they have been properly kept till the period of sowing; 3d. That they be sown at the proper time; and, finally, that the sowing be performed in the proper manner.

The perfection and maturity of seeds can be generally determined by their external and internal appearance; and in many cases by their specific gravity, their sinking or swimming in water being frequently a good test. If the seeds have a plump appearance and clear colour, it may be presumed that they are good. If, in a fair sample, the section present a substance of the natural colour, and the rudiments of the radicle be perfect, there

is every probability that the stock will germinate under favourable circumstances. Seeds of a plant that sink in water when good, are of very doubtful quality when they swim, although, in some cases, they may grow, and especially when they float at first, but after having been moistened some time, either sink to the bottom, or only below the surface. The microscope, in skilful hands, will detect perfections and imperfections, imperceptible to the naked eye. But of all others, the surest test is to sow a small quantity under favourable circumstances, and the proportion which the number of the seeds which germinate bears to the number sown, will afford the most positive proof of the quality of the seed. A quick mode of accelerating the vegetation of seeds, for the purpose of trial, is to sow in a pot, cover them with nearly $\frac{1}{2}$ inch of soil, and plunge the pot in hot stable dung. The covering of soil is made thicker than necessary for the seed when sown for a crop, in order to protect it from the direct action of the steam from the dung.

Seeds may be perfect, but if badly stored, of course their germinative powers become impaired, or totally destroyed, before the period at which they can be sown arrives. Canvas bags, of greater or less thickness and fineness, are found to keep many kinds of seeds exceedingly well. They answer well for all the brassica tribe, pease, beans, and, in short, most kitchen garden seeds. For some, however, which are highly aromatic, paper is considered to be preferable, as it is closer and does not so readily permit the essential qualities of the seeds to escape by exhalation. Brown paper which has been made from old ships' ropes is good for preventing the attacks of insects, owing to the tar, which can still be smelled after the fibrous materials have undergone the process of manufacture. The place in which seeds are kept should be so situated and constructed as to be as little as possible affected by changes of temperature. A cool temperature is best for not exciting the vegetative principle in seeds, and consequently the best for their preservation; yet it should not be below freezing; in fact near, but not lower than 40° is probably that which is most desirable, for at that temperature the water which the seeds contain is at its greatest density; lower or higher it expands, and by expansion the organs of the seed must be more or less disturbed. It should be possible to

exclude the air when too cold and too warm, and if the internal air be too damp, the first opportunity should be taken to induce a free circulation of air when it is in a dry state. The floor of the seed-room should be boarded and dry underneath; or, if it be large, Portland stone cement may be employed. Some tree seeds, such as acorns and chestnuts, soon lose their vitality if kept dry; the best mode of preserving it is to pack them in slightly moist sand, or in tolerably dry loam, and keep them in a cool place till spring; but when about to be sown, care must be taken to cover them immediately, so that they may not be exposed to the effects of the sun's rays, or to drought. Seeds of this description are sometimes packed in slightly damp, well-beaten moss. This substance, growing abundantly in many woods, doubtless forms a natural protection to seeds that drop amongst it, for it retains a certain degree of moisture without being saturated, whilst it resists the vicissitudes of heat and cold, and is not apt to go into a state of fermentation. Seeds closely packed in dry soil, and consequently almost excluded from the air, retain their powers of vegetation much better than those that are hermetically sealed in glass bottles or jars. In the latter case, the air in the jar or bottle must become contaminated by the exhalations from the seeds, and more or less saturated with the moisture they contain. The consequence is, that the seeds are then in an impure, damp, close atmosphere, and in most cases become completely spoiled.

Time of Sowing.—The most favourable time for sowing all seeds indigenous to any country, is when they naturally drop from the plants, except some, such as haws, which hang till they are swallowed by birds, and vegetate after undergoing the digestive process. This rule, however, is not of general application as regards seeds of plants that are natives of a country having a very different climate from that of this, or any other part of the world where they are to be sown. Favoured by mild weather, seeds of exotics may vegetate in autumn, and grow slowly, yet safely, through the winter; but in many cases the same kinds of plants, if raised in autumn, in a climate like that of Britain, would perish during the winter; whereas, if the seeds are well kept, and not sown till spring, the young plants can progress as the weather becomes more and more favourable to their growth. The time

when seeds are self-sown is doubtless the most proper for propagating the species with the greatest certainty in the absence of cultivation, and if no other object were in view, the cultivator might closely imitate nature as to the period of sowing; but he has other motives which render it necessary to deviate from the natural mode. He has to cultivate the plant, not solely for reproduction, but also for its use, or for ornament; and in either case he has to afford a supply to suit the demand, sometimes throughout the year, often for a considerable portion of it. These remarks chiefly apply to such plants as are of an herbaceous nature, and more especially to annuals and biennials. With regard to trees and shrubs, it is, generally speaking, well to adopt the natural period of sowing, if circumstances will permit. At the same time it is highly desirable that the seedlings should only make their appearance at a period of the season which is favourable to their growth. Accordingly, some seeds that do not keep well dry are committed to the soil, or mixed with it, in autumn; but their vegetation is not encouraged till spring. This is done by the process called *stratification*, which consists in placing a layer of seeds on the surface of the ground, then a layer of sand or light soil from 1 to 2 inches in thickness, then another layer of seeds, and so on, the whole being laid so as to form a cone, over which a covering of soil is spread for protection from wet and frost, or, with the view of doing so more effectually, the cone is sometimes thatched. Care must, however, be taken to guard against the attacks of mice and other animals. Small quantities of seeds requiring this mode of preparation may be stratified in boxes, jars, or flower-pots, and placed in a cool situation till spring. It is immaterial whether the seeds are placed in alternate layers, or simply mixed with the soil. The only advantage of the former mode is, that should the seeds or a part of them happen to vegetate before sowing, each layer can be uncovered and taken up for planting without so much danger of breaking as if they were mixed promiscuously with the soil. Some seeds, like those of the hawthorn, require to be in the soil for more than a twelvemonth before they vegetate; and those of the holly two years. When stratified, or mixed with the soil, they occupy but little space, and when vegetation does take place, whether in the first, second, or third spring, the ground

should be prepared, and the vegetating seeds taken out and sown along with the substance in which they have lain; or when they are large, it is sometimes advisable to plant them in drills at proper distances.

Preparation of Seeds for Sowing.—Some seeds, like those of the carrot, which adhere to each other, require to be rubbed between the hands along with dry sand, in order to insure a more equal distribution than would otherwise be the case. Others that are encased in a hard substance, as the seeds of the beet, should be steeped in water till their coating is softened to a considerable extent. Very small seeds are in some cases mixed with sand, or finely sifted soil, in order that they may be more easily distributed over a large extent of ground.

Modes of Sowing.—There are two principal modes of sowing—*broadcast*, or in *drills* or *rows*. Broadcast sowing is merely scattering the seeds over the surface, and is doubtless the most original. But the drill system has of late been much practised, both in the garden and in the field. It has the advantage of admitting of the ground being more expeditiously cleaned and stirred in the intervals, inasmuch as the hoe, or other implement, can be freely worked; whilst in the case of broadcast sowing, no full stroke can be made; for even supposing the plants were to be generally 1 foot apart, every draw or stroke of the hoe must be limited to less than 1 foot along the surface. On the other hand, small plants with spreading roots are, doubtless, best disposed promiscuously over the surface, unless the rows are made very little distant from each other, or not further than the roots of the plants extend. With regard to tap-rooted plants—carrots, for instance—the distance between the rows should be regulated, not so much by the horizontal extension of the roots, as by the space which the tops require, in order to have sufficient light and air.

Seeds will vegetate with due supplies of heat and moisture; but a fertile soil is essential for further progress; thus, the seeds of many plants do not vegetate well in strong loam, although the plants afterwards flourish in soil of that description. In a natural state of the ground, seeds rarely fall upon bare loam, but for the most part among the decayed or decaying vegetable matter with which it is covered; in this the seeds vegetate, and the young plants are nourished by it, until they

acquire strength to enable them to penetrate the loam.

Mr. Pepys, well known for his chemical researches, made some experiments on the vegetation and growth of plants in the pure earths, and also in these with the aid of stimulants and manures. The earths employed were—

Silex, or white sand,.....	75
Alumine, or pipe-clay,	15
Carbonate of lime, or whitening,.....	10
	<hr/> 100

These earths were put in glass pots, consisting of an inverted wine bottle with the bottom ground off. In the first experiment three lupine seeds were planted $\frac{1}{2}$ inch deep on the 26th of April. The earths were kept moist by distilled water and exposed to the atmosphere. On the 5th of June, a small but very weak plume appeared; on the 10th of July, the plant had six leaf-stalks of six leaves each, and on the 1st of August eleven. Being then very weak, and exhibiting no sign of bloom, it was removed.

“In one of the same glass pots, filled with peat and loam, three lupine seeds of the same weight were planted and watered with cistern water each day, and on the twentieth day from planting broke ground; only one was suffered to grow, which was strong and healthy, and on the fortieth day from its breaking ground had twelve leaf-stalks, with six to seven leaves each. Twenty days after it showed for flower, and being taken up weighed $192\frac{5}{16}$ grains.

“April 28, 1843.—Planted three lupine seeds, 2 grains weight each, in the pure earths; watered them with a solution of guano (1 oz. to 20 oz. water); continued the watering to the 14th of June, without any appearance of the plants, examined the earths and found the shells of the lupine seeds, the whole of the pulp in the interior having disappeared.”—(*Journal of the Horticultural Society of London*, vol. iv. p. 58.)

Here it might have been supposed that the pure earths, with the addition of one of the richest of artificial manures, would have answered as well as a compost of peat and loam, but the result proved quite the contrary. In another experiment, four out of twenty mustard seeds vegetated in the pure earths, and were watered with distilled water; the plants decayed in a few days.

Seeds of lupines planted in the pure earths, and watered with a solution of sub-carbonate

of ammonia, $\frac{1}{2}$ oz. to a quart of water, did not vegetate. A similar solution of muriate of ammonia gave a like unfavourable result, as was also the case with nitrate of potash, and with nitrate of ammonia mixed with the soil.

In these experiments, soot mixed with the pure earths answered better than any other substance employed along with them. In April, 1844, three lupine seeds, each weighing 2 grains, were planted in the pure earths, well mixed with 30 grains of soot, and watered up to the 14th of April, when all three broke ground and grew well. On the 10th of June, 20 grains more of soot were applied as a top-dressing, and though the soot remained without apparently mixing with the earths, yet the plants thus treated improved, and on the 25th of July showed for flower. After the earth had been removed from the roots the three plants weighed 215 grains.

It thus appears that though seeds may germinate when sown in the pure earths, and duly supplied with pure water, yet to insure success in the after-growth, the soil must possess certain fertile properties. Now, it may be considered fully proved, that the peat and loam in the above experiments constituted the fertile soil favourable to germination and growth, whilst the composition of the three pure earths was quite the reverse. Fine, light, and rich soil, or compost containing peat or leaf-mould, is favourable to the vegetation of most seeds, and on this account rich compost might be employed with great advantage even in extensive cropping.

The following remarks on the use of compost, with the view of promoting vegetation, are made in the *Gardeners' Chronicle*, 1844, p. 404, by “Falcon,” who says:—

“I have no difficulty in bringing up my seeds, during this unusually dry weather, by pursuing the following system:—Dig and pulverize the earth well, soak it with water (not immediately from a spring—it should be exposed for some time to the air), fine the top, sow the seed in shallow trenches, which is far preferable to broadcast, and then sift over the bed a coating of rich compost; in a few days the appearance of green leaves will reward your trouble. In this way I coax parsley above the ground in three weeks.”

II.—PROPAGATION BY BULBS, CORMS, AND TUBERS.

Propagation by bulbs is easily effected. The

new bulbs may be separated when the leaves of the old plant decay. Those of the garlic, shallot, onion, tulip, &c., are usually kept in a moderately dry airy place for some time before planting. This is done in order that the bulbs may commence to vegetate at the most convenient season, and besides, the bulbs are considered to grow better in consequence of their moisture being to some extent evaporated. By similar treatment, corms, such as the crocus, are found to produce better plants and stronger flowers, than if suffered to remain without removal. Tubers also admit of being taken up when mature, and being kept till the most convenient season for replanting. They may in general be cut into a number of pieces, from which as many plants may be raised, provided there is a perfect eye or bud in each piece. The Chinese yam has not visible buds like the potato, but a number of small wrinkles disposed horizontally appear on its surface, and if the tuber be cut in slices and planted, buds will push from the wrinkles.

III.—PROPAGATION BY DIVISION.

Strictly speaking, propagation in every way except by seed is effected by division. If we propagate by cuttings, suckers, grafts, or buds, we must, in either case, divide the plant to obtain them. Propagation by division is, however, usually understood to imply the parting of such plants as the daisy, aster, sorrel, marjoram, &c. Every one knows that a patch of the daisy can be taken up and separated into a number of plants with roots to each. The aster, and herbaceous perennials that have annual stalks, can be divided with a spade or trowel, and such plants as thyme, hyssop, or box can be dug up and split into slips with some portion of root to each. This is frequently termed propagating by slips. In some cases, the number of plants which can be obtained by division may be greatly increased by introducing a quantity of fine soil among them in order that the lower branches may strike root in it; or the plants may be taken up and replanted deeper than before. Thus, an overgrown box edging may be taken up in spring, partially divided, and then laid in so that the soil may cover the bases of the twigs or shoots; most of them will strike root in the course of the season, and the whole may afterwards be separated into as many plants as there were shoots in the edging. On the same principle

other plants of a shrubby nature may be propagated.

IV.—PROPAGATION BY RUNNERS.

Like the strawberry, many plants emit runners, which proceed along the surface of the ground, deriving nourishment from the parent plant, and develope, at a greater or less distance from it, a bud on the upper side, whilst small projections form on the opposite or under side. These are young spongioles, the rudiments of roots, which, under favourable circumstances, strike into the soil, and assist in nourishing the young plant immediately above them. The growing point of the runner proceeds, and another plant is formed at the next joint or bud, and so on. It will have been observed, that runners cannot well take root in dry weather; but when in contact with moist soil the roots penetrate quickly. To facilitate the rooting, the joint is sometimes pegged down, or a small stone is placed over it. The stone not only keeps the joint close to the soil, but also attracts moisture, yet care should be taken not to place the stone so as to check the growth of the young plant. It should not be placed, for instance, on the bud, but a little behind it. In propagating by runners, if the object be to obtain as many plants as possible, the old plants should be prevented from bearing flowers and fruit, by cutting off all flower-stalks as they appear. If particularly strong plants are required, the runner should be stopped after it has made one or two joints. By so doing, the whole flow of sap conveyed from the old plant by the runner, will be appropriated by one or two plants, instead of proceeding onward to supply a number. It is like shortening a shoot to a few eyes near the base, which then push strongly; whilst, if the shoot is left entire, the flow of sap is divided amongst a number of buds, and it then frequently happens that the lower ones do not push at all.

V.—PROPAGATION BY SUCKERS.

Two kinds of suckers may be distinguished, namely, *root-suckers* and *stem-suckers*, sometimes called slips.

A *root-sucker* proceeds from the underground part of a plant, sometimes close to the stem, as in the gooseberry and currant, frequently at a considerable distance from it, as

in the plum, robinia, and poplar. When the roots have taken up a large quantity of sap, and when from some cause the leaves do not perform their functions, or when they are diseased, or mostly destroyed by insects, tubercles are formed on the roots from an exuberance of sap not otherwise expended, and from these, adventitious buds are produced, which push above ground, fed by the roots from which they spring, and in some cases they also form young roots in connection with themselves. When this takes place, the sucker is more independent of the parent plant, and may be removed and replanted with the greatest chance of success. By suckers are propagated the filbert, raspberry, rose, lilac, poplar, and elm, sometimes the gooseberry and fig, and occasionally the apple, pear, and plum for stocks. With all these the mode of proceeding is very simple; it merely consists in removing the suckers with all the roots that properly belong to them, and planting them. This should be done at the time that would be most proper for transplanting the plant from which they are taken. Whilst it is desirable that suckers intended for propagation should be taken up with plenty of roots attached, yet, in doing this, care should be taken to injure the roots of the parent plant as little as possible. If the suckers spring from a thick root, the soil should be removed, and instead of severing the large root, a slice of it can be detached with the sucker. In general, plants propagated from suckers occasion inconvenience, from having a greater disposition to produce suckers again than those propagated by other means. The best way of preventing this, when no increase is desired, is to be vigilant, and when a sucker makes its first appearance, instantly to check it. This being attended to, and the plant at the same time well managed, its foliage being kept clean and healthy, so as to elaborate the full flow of sap, the disposition to produce a superabundance of suckers will be greatly diminished.

Stem-suckers proceed from the base of the stem, when this part is under the surface, as when soil is raised higher than the collar of the plant, or when a cutting, such as that of a gooseberry or currant, is inserted 8 or 9 inches in the ground. The growth and increase of these suckers is made at the expense of the part of the plant above them. When the old stem gets dry and hard, with sap-vessels much contracted as compared with those of the young wood of the suckers, the sap tends to flow

into the latter, and they accordingly exhibit great vigour; whilst the old plant surrounded by them gets more and more stunted in its growth. A vigorous sucker, in proportion to the breadth of foliage which it exposes to the light, contributes in a like ratio to the formation of roots. All those which have derived their existence from a sucker are more in connection with it than with any other part of the plant. The juices which any particular portion of the roots imbibe have a tendency to flow towards the part which bore the leaves through the agency of which that portion of roots was formed, and simultaneously with it a set of buds. The leaves ultimately drop, but the buds remain and are in direct communication with the recently formed roots. It is therefore natural to suppose that the fluids absorbed by the roots will flow in the most direct channels towards the buds more immediately in connection with them, that is, to those formed on the sucker to which the roots belong. If the communication with most of these buds were interrupted, as would be the case if the sucker were cut off nearly close to the ground, still the sap would tend to flow in the same direction, and act in the first place with great force on such buds as still remain. If there be any latent buds they will be stimulated; and in many cases adventitious buds become, under these circumstances, developed into shoots. These shoots originating close to the ground frequently strike root and form rooted suckers. When they do not naturally strike root, they may be encouraged to do so by earthing them up with some good mould, which should be kept moist by mulching when necessary. If the plant is one of those of which the suckers readily strike, and make sufficient roots in the course of a season to supply them, when taken up as distinct plants, the principal stem may be cut over by the surface of the ground, provided it is of less consequence to preserve it than to obtain a number of young plants, by the production of suckers which the cutting down of the old stem would encourage. But before this proceeding is adopted, some precautions should be taken in case the cutting down of the stem should not have the desired effect. If suckers have already made their appearance, there is no danger; but if there are no symptoms of them, it must be considered whether the plant is one that infallibly produces suckers when cut down. Again, if the suckers require more

than one year to root properly, and if the amount of foliage which they bear is but little compared with that of the old plant, it will not be advisable to cut down the latter till after the first season, because, if done too soon, the roots would be deprived for two seasons of the action of a proportionate amount of foliage, and although, from their previous vigour, they may act tolerably well for one season, yet in a second season their action will be greatly limited, owing to the scanty formation of fresh spongioles, in consequence of the little foliage produced in the previous summer.

When the suckers are taken from the parent stock, they may be considered plants, and treated as such. In many instances, however, it is likely that the quantity of roots will be small in proportion to the rest of the plant; and this also will probably be the case when the sucker has received a large share of nourishment from the roots of the mother plant, as well as from those of its own formation.

Greater care will then be advisable to reduce the plant somewhat in proportion to its roots, to plant it out for nursing in rich soil, to water it moderately, and to mulch the surface of the ground. After growing in the nursery for a season or two, both roots and top will be in due proportion to each other, and the plant will be fit for transplanting to the place where it is to remain.

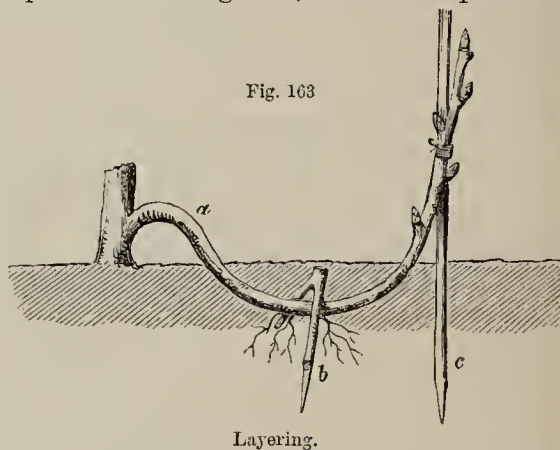
VI.—PROPAGATION BY LAYERS.

A layer is a branch or shoot, part of which is introduced into the soil, and strikes root whilst fed by the parent plant, with which, however, its communication is partially interrupted to induce the returning sap to form roots where checked, instead of returning to the parent stock. When treating of the flow of sap it was stated, that when absorbed by the roots it passes upwards through the alburnum and the youngest layers of wood to the leaves, and that, having been exposed in the tissue of these to the influence of light, it returns by the inner bark, forming woody matter, and depositing secretions in its progress, a portion extending to the roots, to which it supplies organized matter for the growth of spongioles, or, in other words, for the production of young roots. Now, as the upward flow of the sap is by the young wood, it is evident that we may cut off from a branch a ring of bark, including the liber or inner bark, with-

out stopping the flow of sap by the alburnum. The returning sap will, however, be deprived of its regular channel when it reaches the place where the bark and inner bark were removed by ringing. If this part is in dry air, the obstructed sap forms a swelling on the upper edge of the ringed space; or if it protrude a little in the form of cellular tissue, it soon dries, exhibiting a margin of irregular excrescences. But, when the ringed portion is placed in the soil, the cellular tissue, protected from the drying influence of the air, forms granulations, which by degrees elongate and assume the form and office of spongioles. It is upon these principles that the operation of layering is founded. The shoot or branch is kept alive by the flow of sap from the mother plant, and various means are adopted to check its return, and induce the formation of roots on the layered branch, where it is placed in the soil. When these have formed in sufficient quantity for the entire support of the layer, it may be severed from the parent plant, and removed at the proper season for transplanting the species.

According to circumstances, various modes of layering are adopted; the principal are simply bending in the earth, twisting, incision, tongueing, slitting or heeling, strangulation or wiring, ringing, piercing, serpentine arching, insertion of the growing point, and circumposition. These having been detailed, and the principles upon which they are founded understood, the modes of operation can be varied still more.

1. *Simply Bending in the Earth.*—This is represented in Fig. 163, where *a* represents



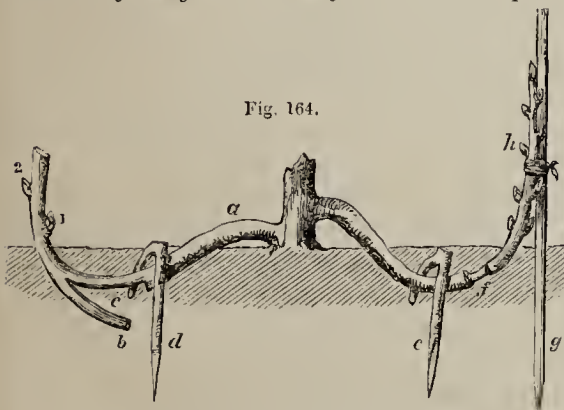
the branch to be layered; *b*, a hooked peg to keep it from springing up; *c*, a stick to maintain the extremity of the shoot in an upright position. It will be seen that this is a very simple operation, consisting in making a slit,

into which the shoot is bent, secured, and covered with soil. The extremity of the shoot may, in most cases, be more or less shortened, so that the buds left may have the more sap to enable them to push vigorously. When a straight stem is required, the terminal bud may be preserved, and the end above ground kept upright by a stick. Or, the shoot may be cut down to two buds above the surface, and, when they push, the strongest may be selected to be trained upright for the future stem, and the other rubbed or cut off. If, in the course of the season, buds should push into shoots on the part of the layered branch, between where it is laid in the ground and the parent stock, they should be checked, otherwise, from their upright position, the sap would flow into them rather than along the more depressed part towards the extremity where it is wanted to produce leaves; for on the elaborated sap returned from these, the formation of roots depends.

2. *Twisting*.—This is performed in the same way as the preceding, except that the branch is twisted, in order to check the returning sap, and, consequently, favour the emission of roots.

3. *Incision by Splitting*.—Small branches are sometimes split by thrusting a sharp-pointed knife through the middle of the branch at the part which is to be laid in the earth, and then splitting it longitudinally to the extent of 2 inches or so, more or less, according to the size of the branch. The parts are kept separate by a piece of wood or stone. The split, of course, occasions an obstruction of the sap, and allows of the emission of roots by the edges of the cleft.

4. *Tongueing or Heeling*.—This is repre-



Layering by Tongueing and Ringing.

sented by Fig. 164, where *a* represents the branch cut half way through at *c*, by entering

the knife about the lowest part of the bend below the bud *b*, and cutting upwards; the branch, being then placed at the proper depth in the groove made for its reception, is kept from springing up by the hooked peg *d*. In placing it, care must be taken to keep separate the divided portions at *c*, for if in contact they would unite, and the object of making the cleft would be defeated. A piece of stone or wood is sometimes employed to keep them apart. It is also necessary to observe, that all buds, including that at *b*, should be rubbed off, or cut out, before the shoot is laid down. Now, it will be seen, that the sap can ascend by the upper side into the buds 1 and 2; but when these expand into shoots and leaves, and when the latter are able to return elaborated sap, a portion will return to the stem, whilst another portion will go towards *b*, and accumulating there, it must break out in the shape of roots. The bud 1 will have the flow of sap more direct, because the vessels on that side are entire; but it will also find its way to bud 2. The sap from the leaves produced by the latter will, however, tend to return towards *b*, in consequence of that part being on the same side. The future shoot and foliage on that side, being most in connection with the part from which roots proceed, should be encouraged. The reason of cutting below the bud at *b* is, that when a shoot is cut a little above a joint or bud, the divided part is apt to die up to the next joint; but when cut immediately below the joint, the heel usually keeps alive to the joint situated at its extremity. Instead of the tongue or heel being formed on the under side of the branch, it is sometimes made on the upper side. The branch is then twisted, so that the tongue may be placed in a perpendicular position, and in a downward direction. In other cases, it is cut on either side of the branch; but, in general, it is preferable to make an incision on the under side, unless the shoot is of a brittle nature and may bend, when cut on the upper side, with less danger of breaking. Some, after raising the tongue, have split it up the middle, and, in some cases, it is said, with advantage.

5. *Strangulation or Wiring*.—If a wire is twisted tightly round a branch, the ascending sap will flow along the vessels of the albumen, but the returning sap, descending by the inner bark, will be checked. Woody layers continue to be formed so long as the outside bark admits of being compressed; but by de-

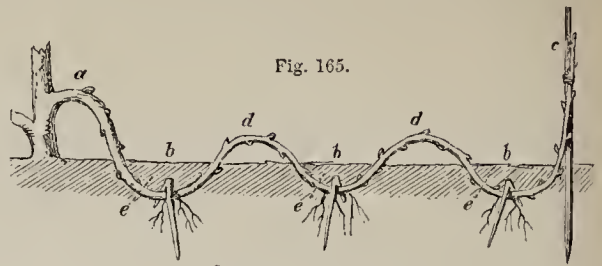
greens the portion of it within the ring becomes hard, and so compact as to prevent the return of the sap below the ring, and, of course, the further deposition of woody layers. An accumulation of the returning sap then takes place above the wire. Exposed to the drying influence of the air, roots do not readily break out in consequence of this accumulation; but an increased deposition of woody matter is indicated by the swelling of the branch to a much greater thickness immediately above the wire than below it. When, however, the part around which the wire is twisted is laid in the earth, the accumulated sap tends to form roots; and to encourage their breaking out, the part above the ring is sometimes pricked with a sharp instrument, in various places, quite through the inner bark.

6. *Ringing*.—This mode is represented in Fig. 164, where *e* is a hooked peg, the use of which is obvious; *f*, a portion of the branch from which a ring of bark has been removed; *g*, a stick, to which the extremity of the shoot *h* is trained. The ring at *f* should be taken off quite through the inner bark, otherwise the returning sap would pass by it to the stem, and thus the object of ringing, to interrupt it, would be defeated. Ringing is to be preferred to strangulation or wiring, inasmuch as the granulated cellular tissue has a clean-cut edge to issue from, and on which it can sooner accumulate in sufficient quantity to form protrusions, in the shape of spongioses, than it can when it has to overcome the resistance of sound bark, above the wiring, before it can burst out; besides, previously to its doing so, part of it is appropriated for the deposition of woody layers.

7. *Piercing*.—The branch, where laid in the ground, is sometimes pierced or punctured. The returning sap is thereby obstructed, and the emission of roots encouraged. But punctures are more apt to cause disease than clean cuts; therefore, very small circular notches will answer the purpose better, except when the branch is of a tender, succulent nature, and liable to bleed when cut.

8. *Serpentine Layering*.—This mode is very applicable to the vine, wistaria, clematis, and other plants, that make long running shoots. It is represented by Fig. 165. The shoot *a* is laid at every 2 feet, or less, according to the nature of the plant, its pliability, and the situation of the buds. Each curve above ground *d, d*, must be furnished with a bud or

buds; whilst from the portion below ground, held down by pegs *b, b, b*, the buds must be



Serpentine Layering.

rubbed or cut off. The extremity *c* is supported by a stick, and when the shoot is sufficiently rooted at the different parts laid, it is cut as represented by the dotted lines *e, e, e*. When this mode of propagation is adopted in summer with a growing shoot, the latter must be layered as it proceeds in growth, and the leaves on the part above ground should be preserved and encouraged; consequently, the shoot will have to be laid shallow, and the curves to be but slight. Sometimes, pressing the shoot at its joint the depth of its thickness in the soil, and then laying small stones upon it, will be sufficient.

9. *Layering by Insertion of the Growing Point*.—Many plants that emit few roots, and these but slowly, by the previously detailed modes, will produce them in surprising abundance by merely inserting the growing point in the soil. Take, for instance, the rubus, gooseberry, or currant, and, as soon as the shoots have acquired some length and firmness, insert the growing points in well-dug soil, and before autumn a large bundle of roots will be formed, with a bud, which must be carefully preserved in transplanting, and afterwards trained to form a stem. This mode, though not in general essential for the propagation of either the gooseberry or the currant, might yet in some particular cases be advantageously adopted; for instance, when a sort is required to be increased as quickly as possible, a number of strongly rooted plants may be obtained long before such could be produced by cuttings. This mode of propagation deserves notice, for it can easily be tried, and doubtless will often be found successful in the case of many kinds of plants that are difficult to propagate by other means.

10. *Circumposition* is an old term for a mode of propagation employed in cases where the branch is far from the ground, or when, from stiffness, brittleness, or other circumstances, it cannot be bent down. Whilst the branch, for

any of these reasons, retains its position, some soil or compost is carried up, and, in various ways, made to surround it. For holding the soil, a box, garden pot, basket, or any other article, adapted so that the branch can be introduced into the interior, may be used. A garden pot, cut down the middle before the clay is burned, will answer; the branch can be inclosed between the two halves, which close against each other, except where the hole in the bottom allows room for the branch to be introduced into the pot. The pieces, of course, require to be bound or hooped together. This, however, is rendered unnecessary by the arrangement represented in Fig. 166, where *a* is a slit in the side of the pot, sufficiently wide to admit the branch; *b*, a post to support the pot at the proper height; *c*, a stick to keep the branch upright. After the branch has been introduced into the pot, and placed in its proper position, the slit above and below it, is closed by two slips of thin tile, or slate; and the pot can then be filled with soil. From being raised in the air, the soil will be apt to dry rapidly; this should be prevented by mulching it with moss, which should be kept moist, and it will also prove advantageous to cover the whole surface of the pot with moss, in order to prevent evaporation through the pores of the material. Pots or boxes made of slate, not being porous like those of earthenware, would be proper for this mode of propagation.

The Chinese ring a part of a branch, and then fasten round it a large ball of clay and cow dung, well incorporated, and similar to our grafting clay; and the whole is maintained in a moist state by means of a vessel placed above it, and kept supplied with water, of which enough is allowed to escape by a small hole at the bottom. The mode was practised in Britain more than 130 years ago. Reid, in his *Scots Gardener*, published in 1721, after describing the mode of propagation by circum-position, says:—"I have effected this with clay

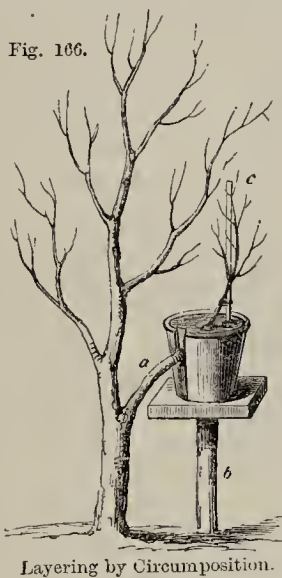
and cow's dung, well mixed (after part of the bark has been taken off round), and wrapped about with a double or triple swaddling of straw or hay ropes."

The vine, and various other plants, will strike root by merely surrounding the branch or shoot with grafting clay; but, in general, ringing, or some of the modes of incision, should be employed when layering by circum-position is performed.

VII.—PROPAGATION BY CUTTINGS.

A cutting for propagation is an entirely detached portion of a plant, usually a shoot, or part of a shoot, furnished with buds, or with buds and leaves. When properly selected, duly prepared, and placed under favourable circumstances, the cutting emits roots, and thus an individual plant may be increased to an extent corresponding to the number of parts eligible for cuttings which the plant can afford at once, or in succession.

If a plant be cut over by the surface of the ground, and, consequently, be deprived of its nourishment from the roots, it will, notwithstanding, remain alive; and its buds will continue to attract the sap from the vessels with which they are connected, and will expand into leaves. These, as well as the others with which the cutting may be already furnished, will continue to perform their functions nearly as before the separation of the plant from its roots, that is to say, they will elaborate the sap till all that can be drawn from the cutting is exhausted. As long as the leaves have a supply of sap, so long will they continue to form cellular tissue, and when this is formed, it will naturally fall into the proper channels, and pursue its usual course, as far as possible. It will descend from the leaf by the vessels in the petiole, and by the inner bark of the shoot, depositing secretions, and forming woody tissue in its progress. But it is not usual for the tissue, organized by the leaves, to be wholly monopolized by the stem and its parts above ground; for, whilst a certain quantity is thus appropriated, a considerable portion passes on to the root, and adds to their growth and extension. If a plant be 3 feet in length from a certain part of a shoot to the extremity of the roots, then the sap elaborated by the leaves on that part deposits more or less substance throughout the whole length of 3 feet. Moreover, if the soil be in a favourable condition,



especially as regards temperature, an extension of the extremities of the roots or spongioles is effected. But instead of the process extending along the assumed distance of 3 feet, or more, if a cutting, 6 inches in length below the leaves, is made, presuming these to continue their functions as usual, the cutting will receive and appropriate the share of elaborated sap due to a portion of shoot 6 inches in length; whilst the tissue, not so appropriated, and which would have extended 30 inches farther towards the extremity of the roots, accumulates where its channel of communication with the latter is cut off, that is to say, at the base of the cutting. There, it forms a callosity of organized matter, which, under favourable circumstances, protrudes, and ultimately assumes the form of roots. The cutting has now become a plant. This result depends, however, upon various circumstances, to which it is necessary to advert. The cuttings require to be selected of the proper age; they should be inserted at the proper season, and in a suitable medium; and they should afterwards be kept in a well-regulated condition, as regards heat, moisture, and light.

Selection.—Cuttings should be taken from healthy plants, and from parts of these which are not in a weakly state; for if the shoots or branches of a plant are not in a condition to make a fair growth with a supply of nourishment from the roots of the parent plant, they cannot, when made into cuttings, be expected to possess sufficient energy to produce a good plant. At the same time, excessively vigorous shoots, accustomed to receive a very abundant supply of nourishment, are not so well able to keep alive, when deprived of that supply, as others that have been less highly fed. Some kinds of trees, as the willow and poplar, strike from either old or young wood; but most strike more readily, and make the best plants, from well-matured shoots of the current year's growth. In the case of hard-wooded plants difficult to strike, considerable nicety is required in selecting a portion of the shoot, the wood of which is neither too old and hard, nor too young and soft; for in the former case, roots are not readily emitted, whilst, in the latter, the cuttings are apt to damp off. A knowledge of the proper degree of firmness which the cutting should possess, can only be acquired by practice, and this differs in different plants. When not exactly known, it is well to insert cuttings of different degrees of

firmness, and observe for future guidance the condition in which they succeed the best.

Time of taking off Cuttings.—The cuttings of hardy deciduous trees and shrubs should be taken off after the fall of the leaf, and before the sap rises in spring. The sap is then in a condensed state; as it expands, by the increased warmth of spring, the buds swell, and sap is returned to form callosities, and the more readily if placed in soil that is moist and warm. The worst time for taking cuttings from these kinds of plants is when the sap is in full flow, and when the leaves from buds formed in the previous summer are just expanding. At that period of their vegetation, they evaporate the moisture contained in the cutting with great rapidity, and, at the same time, return organized tissue but slowly, so that, before enough of it to produce roots is accumulated, the cutting is exhausted. As a general rule, cuttings should be taken off, either when the vegetation of the plant is in a dormant state, or when it is active and has made a new shoot, with leaves so far matured as to be in the act of forming abundance of woody tissue.

Preparation of Cuttings.—There are trees that strike root so readily, that a piece of branch or stem may be sharpened like a stake, and then driven into the ground, when they become plants. In the south of Europe, where the ground is much warmer than in this country, branches of apple or pear trees, of the thickness of a man's wrist, are cut into lengths of 2 or 3 feet, pointed, and driven into the ground, where they strike root, and soon form strong stemmed plants. Stout willow stakes are sometimes driven in, to form a fence in watery places, or to mark a boundary in such situations, and they soon take root. In one instance, willow stakes for this purpose had been sharpened at the smaller, or top end, and driven in bottom upwards; yet they grew, although not so freely at first as if the sap had risen through vessels not so inverted. Cuttings of the gooseberry, currant, and some other plants, emit roots, not only from the callous substance at the lower end of the cutting, but also along the side. In these, and other kinds of cuttings from deciduous trees, the buds on the under-ground part of the cutting must be cut, picked, or rubbed out, otherwise they would, sooner or later, push into shoots. It may be observed that, in the gooseberry and currant, the leaves have chiefly per-

formed their office when the fruit is ripened off; and, as this occurs early in the season, cuttings made at that time and planted in warm, moist soil will form roots before winter, and will, consequently, be ready to push into vigorous growth early in the ensuing season, and before cuttings of the same sort, inserted in spring, could have formed a single root. Thus, the plants from cuttings made early in autumn will be nearly a year in advance of those planted in spring. The gooseberry and currant are mentioned as familiar examples of what may be observed and taken advantage of, in regard to the propagation of other plants. In such cases, the leaves must be taken off, otherwise they would evaporate the moisture of the cutting.

When plants are difficult to strike by the ordinary mode of cutting off a portion of branch or shoot, for immediate insertion, it is a good plan to ring it below a joint about mid-summer. The returning sap being checked, a swelling commences above the ring, and continues to increase till active vegetation ceases in autumn. The branch should then be cut off below the ring, and laid in the soil till spring, in order that the swelling may be softened by the moisture of the soil, and to facilitate the emission of roots. In spring, the cutting is taken up, and the ringed portion cut off close by the under part of the swelling; the cutting is then again inserted in the soil to the proper depth, the top having been previously shortened to a few buds above the joint corresponding with the surface. Instead of ringing, a ligature is sometimes employed to obstruct the returning sap. For this purpose, a small wire is generally used, but, in many cases, a piece of fine twine, drawn very tightly, will answer better, as it is not liable to corrode, like metallic substances.

Instead of being cut off, the portion to be propagated, consisting of a lateral shoot, is occasionally torn off with a *heel*, the separation presenting a somewhat oval surface which is smoothed with a sharp knife. The section, then, is oblique to the direction of the fibre, and is, of course, larger than if it had been made right across the shoot, consequently, it presents a larger surface for the absorption of moisture.

Cuttings of some things strike more readily when, after having been cut across, they are split upwards, about half an inch, more or less according to the size of the cutting. The shoot

should be cut with a very sharp knife immediately below the joint. Some of the lower leaves should be cut or clipped off very little farther from the base than the length to which the cutting is inserted in the ground. The older leaves elaborate more sap for the formation of roots than the very young ones; and, from being near the moist surface, they absorb moisture, or, at least, they do not evaporate so much as when they are elevated from that source of moisture. The petioles of the leaves to be removed should be cut off as close to the stem as can be done without injuring the bark, or the vessels of the stem. When much of the petiole is left, and buried in the moist soil, it is apt to rot; and from decaying matter being thus produced in the vicinity of the cutting, and, in fact, connected with it, the damping or decomposition of the cutting itself is induced.

With regard to the preparation of cuttings, and the importance of leaving the proper quantity of leaves, some excellent remarks are made in the *Gardeners' Chronicle*, 1844, p. 540, by Mr. Wood, who says, "It is the common practice to cut through the joint and remove three or four of the lowermost leaves; but the removal of these, I am fully convinced, is of great disadvantage, as it is generally admitted that the foliage has an office to perform, viz.—that of elaborating the sap or juices of the plant. The sap ascends by the minute vessels of the cuttings, and, entering the leaves already formed and undergoing the elaborating process, is converted into cambium, or the proper juices of plants, by the influence of light and heat. Afterwards it descends, forming wood in its course, but in considerably less quantity in cuttings than in rooted plants. After it has reached the base of the cutting, it comes into immediate contact with the soil, or compost, of whatever nature that may be, and there it assumes a congealed appearance, or white warty substance, which, owing to the sap continually descending, enlarges until it is forced into different directions in the shape of roots. These supply the plant with food, growth commences and proceeds, and the plant elongates and soon becomes established. If we deprive a cutting of its lowermost leaves, we deprive it of a considerable portion of its power to emit roots. I have inserted a great quantity, with every leaf attached, and these retained the same healthy appearance as before they were taken off the parent plant;

many of them rooted rapidly, and not one leaf died until after they had become well-established plants. It is evident that the leaves were of service to the cuttings, from their remaining so healthy; these cuttings were inserted deep enough to bury in the soil the whole of the leaf-stalk of the lowermost leaf. It is worthy of remark, that those cuttings having the largest leaves rooted quickest; thus showing that the descent of the sap was stronger and quicker in them than in others with smaller foliage, but which, nevertheless, also succeeded well. How different was the ease of some tried on the old plan of removing the leaves! Many soon became languid, some ultimately withered away; and those which did succeed were much slower in emitting roots. In removing the leaves, generally a small portion of the foot-stalk is left, which sap enters, but, on account of the leaf being absent, is not elaborated; consequently, these become dropsical, and damping off very often, kill the cutting. This would not have been the case had the leaves been left on."

The substances in which cuttings are struck are various; but silver sand, white and pure, is that which is most in use, and, on the whole, found to answer best. It is free from decaying matter, and therefore does not induce putrefaction. It is porous, and affords a ready passage for the spongioles; yet, being fine, it retains moisture by capillary attraction. It contains very little nourishment; but scarcely any besides what may be dissolved in the water is required, till rootlets begin to be formed. The sand, as already mentioned, should be pure and free from the oxides of iron. Many plants, such as laurels, some kinds of roses, chrysanthemums, &c., will strike in common garden soil. Various other substances, such as powdered charcoal, brick-dust, burned clay, chopped moss, and water have been employed.

Charcoal has the property of absorbing gases that might otherwise prove injurious to the health of the cutting by inducing putrefaction; it likewise retains moisture within its pores. It has been successfully employed alone, or mixed with other substances.

Mr. Wood, in the article already quoted, states, that for salvias, petunias, fuchsias, verbenas, heliotropiums, anagallises, &c., together with several cobæas, lophospermums, and the like, charcoal is an excellent ingredient in the soil used for their propagation. He also found that cuttings of *Abutilon striatum*, fuchsias,

and various other green-house plants, succeeded well when inserted into powdered charcoal alone; nevertheless, he prefers mixing it with a little good soil and silver sand.

Brick-dust has also been successfully used in striking cuttings, by Mr. Drummond, formerly of Howick Hall, who says, "My first trial was with the heliotrope, for which I used common bricks that had not been over-burned, first reducing them to powder, and filling a shallow seed-pan, fifteen inches in diameter, the coarser particles being placed at the bottom as drainage; the cuttings were then planted over the whole surface. These were firmly rooted in a shorter time than others planted amongst sand, loam and sand, or leaf-mould and sand, although receiving the same treatment, with this difference—that those in brick-dust required less water. Brick-dust, being an absorber and retainer of moisture, requires but a small quantity of moisture; therefore, the larger the pan is the more holes there should be in the bottom, and the coarser should the substances used for drainage. Should the brick-dust become too damp, it may be partly remedied by placing the pan on slate, or any other black body, without abstracting the heat, as a black substance absorbs heat freely, but readily parts with it to surrounding bodies. If a cutting pot or pan were blackened, it would perhaps be greatly in favour of the young plant; but this experiment I have not yet tried. From the success attending the cuttings of the heliotrope, I ventured to try those of various plants, such as pelargoniums, fuchsias, roses, *Euphorbia jacquiniiflora*, *Ipomæa Learii*, and *Passiflora Loudonii*, all of which rooted freely.

"When brick-dust is used, it matters not what the diameter of the pan may be; the cuttings can be planted over the whole surface with little fear of their damping off. The pan should be plunged to the rim in leaf-mould, and freely exposed to the sun in a hot frame, that the brick-dust may acquire a certain degree of heat and moisture before the cuttings are put in, and when planted, they should be immediately taken back to the frame. If the hot-bed is made on the same construction as for early melons, or cucumbers, rather rough leaf-mould, to the depth of 4 inches, may be spread upon the surface, and upon that, 3 inches of pounded bricks; if this is rendered firm and level, the cuttings may be planted out upon it in rows. This method is well

adapted to extensive places, where a great number of plants are required in spring to decorate the flower-garden.”—(*Gardeners' Chronicle*, 1842, p. 742.)

Burned clay is a substance nearly allied to the preceding: it is a powerful absorber of ammonia. It may, therefore, be advantageously employed in cases where the cutting requires other nourishment than water, and yet will not succeed in rich garden soil.

Many plants will strike and grow in moss, such as sphagnum chopped; and if the plants are to be grown for some time in the pots in which they are struck, some leaf-mould, mixed with the moss, will be advantageous.

Cuttings of many plants will readily strike root if their ends are put in water, provided it be of the proper temperature. Bottles, vials, or jars, may be employed to hold the water; but, as light is not necessary for the production of roots, which are usually and best formed in the dark, the vessel, if transparent, should be shaded. Roots growing in water are disposed to subdivide exceedingly, so that many are as fine as hairs, and when taken out of the water, are too delicate to act well in the soil. It is therefore advisable to remove the cuttings struck in water at an early stage of the growth of the roots, before their length becomes too much out of proportion to their thickness. It should be observed, that the soil in which plants struck in water are planted ought to be fine, and kept moist; and the plants should be carefully shaded till they strike fresh root.

The following materials, which may be advantageously employed in striking the cuttings of almost any sort of plant are recommended by a correspondent of the *Gardeners' Chronicle*. He says:—“Provide either broken potsherds, pebbles, or chips of stones from a mason's yard, and place them in the bottom of the pot. Over these put rough fibrous peat, or turf; this will act as drainage, which is most essential; then prepare peat, loam, and silver sand, in equal parts, with the addition of a little powdered charcoal; let these be well incorporated together and passed through a fine sieve; put this compost on the top of the above-mentioned drainage, and press it well down. This must be in sufficient quantity to reach within $1\frac{1}{2}$ inch of the top of the pot. Finish with pure silver sand, and let the whole be well watered, to settle all down before the cuttings are put in.” The cuttings should then

be inserted into the sand, and watered to settle it round them.

Insertion.—Cuttings of hardy plants that strike in the open air are sometimes inserted by means of a dibber; but it is always better, when circumstances will permit, to cut off, by a line, a straight edge in the dug soil, and place the prepared cuttings against it, pressing the soil closely round them. When propagation is effected under glass, and the cuttings are small, a pointed stick proportioned to their size is employed. Some kinds do very well when planted equally over the whole surface; others do better when inserted near the sides of the pot, a circumstance which is not easily accounted for, but that such is the case is a well-known fact. The roots of a plant increase much more readily when they reach the sides of a pot than they did previously when in the soil. Stones, in arable land, have a similar effect; for they have been frequently observed matted with roots. This may be owing to there being a less cohesion between the soil and the stone than between the particles of the soil itself, and, consequently, a more free passage for roots will be afforded in the former than in the latter case. Moreover, moisture is generally to be found condensed on the sides of the pot; for if the pot should be colder than the soil within it, condensation will take place on the inner surface, and if it be warmer than the soil, then it will warm the air in contact with its interior, and moisture will be condensed on the adjoining colder particles of the soil, so that in either case there will be moisture between the soil and the sides of the pot; and thus the production of roots is encouraged. Cuttings, particular cases, are therefore inserted at the sides of the pot, sometimes with their ends against its bottom, against the sides of a smaller pot within the cutting pot, or resting on potsherds placed at the proper depth below the surface. In putting in the cuttings, the soil or sand should be pressed with the pointed stick, as in planting with the dibber, and when the pot is filled, the cuttings should be watered, for this will close the sand about them better than any other process.

Mr. W. P. Ayres gives, in a few words, some very good directions for propagating by cuttings. He says:—“For cutting-pots I generally use 48's, prepared in the following manner: Over the hole at the bottom I place an inverted 60-sized pot, and round it potsherds, broken small; over these some moss, and then

fill up with a compost of peat, sand, and leaf-mould, in equal quantities, leaving about half an inch at the top for white sand, which runs into the holes as the cuttings are inserted. A stock of pots thus prepared should be kept in a frame or propagating house, as nothing is so injurious to cuttings taken from plants growing in heat as to put them into cold soil. Cuttings cannot be too short if they have the necessary buds to form a plant; neither can they be inserted too shallow if they are made firm in the pots."—(*Gardeners' Chronicle*, 1843, p. 116.)

Temperature.—If a well-rooted plant be kept in a high temperature, whilst its roots, on the contrary, are in a low one, the parts above ground will be stimulated into rapid growth, but the roots will increase very little, for the returning sap is checked when it reaches the parts colder than itself. When the soil is as warm as the air, or somewhat warmer, the growth of the roots is in proportion to that of the top; and, if the soil be considerably warmer than the air, the disposition to produce roots will be greater than that to produce tops; and this is the relative condition which should be maintained between the soil and the atmosphere in striking cuttings, that is to say, the bottom heat should exceed the average top heat. With regard to the proper degree of these, no precise data can be given, as it varies in different plants. In general, the temperature should be higher than that in which the species naturally grows. For example, the hawthorn, wild pear, and many other trees indigenous to Britain, rarely, if ever, strike root from cuttings in the open ground, but when placed in a strong, moist bottom heat these, and most hardy trees, strike readily. In regulating the temperature, it is necessary, in the first instance, to take into consideration that in which the plant from which the cuttings are taken has been growing. Sometimes, the plant is forced, in order to produce shoots for cuttings; the latter, in that case, must not be placed in a lower, but rather in a higher temperature than that to which they were subjected on the parent plant. Cuttings taken from deciduous plants in a dormant state, and furnished only with buds, should be placed, at first, in a temperature very little higher than that which is sufficient to excite and swell the buds of the parent tree. As the buds of the cuttings expand, the temperature should be increased in a higher ratio than that which brings the

tree naturally into leaf, or which causes it to push into shoots; and whilst the process is going on, care must be taken that the soil is warmer than the atmosphere. In short, if the buds are not driven out too rapidly, and if the heat is afterwards increased as much as the expanding foliage will bear without becoming weak, thin, and unsubstantial, and if the bottom heat is always increased in a ratio higher than the mean temperature of the atmosphere in which the foliage is growing, roots must ultimately be produced, if the cutting remain healthy. If, on the contrary, too much top heat is given, and too little bottom heat, the foliage will be imperfect, and unfit to elaborate properly, even a limited quantity of sap, and that little will be checked on reaching the lower part of the cutting, placed in the cold soil, and the formation of roots under these circumstances will not be satisfactory, if it take place at all. If both top and bottom heat are too low, vegetation must of course be languid; yet the cutting, partially excited, will waste during the long period which must elapse before roots can be formed to supply it with fresh nourishment. The heat, whatever may be the degree of it which the nature of the cutting may require, should be steady, or nearly so; for cuttings will not bear such vicissitudes as well-rooted plants will do. Tropical plants naturally experience comparatively little variation of temperature, day or night, summer or winter; and, in propagating them by cuttings, the temperature should vary still less; in fact, it may be steady. A somewhat greater range may be allowed to plants indigenous to temperate or colder climates; but by no means ought this to extend to the extremes of temperature which, during even the growing season, occur in most of those climates. This remark refers to the top heat; as for the bottom heat, it should not be high at one time and low at another. If it be found necessary to increase the bottom heat, it should be regularly made every day a little higher than on the one preceding; occasionally, it may be the same for several days; but care should be taken to prevent its falling lower, at any time, than in the preceding day or night.

Moisture.—The extent of surface by which a cutting can absorb moisture, for supplying evaporation, is small, compared with that possessed by well-rooted plants. It is therefore necessary to adopt means to limit the amount of evaporation, so that it may correspond, as

nearly as possible, with that of absorption. The free air is frequently too dry for delicate cuttings, on which account a sort of artificial atmosphere is formed for them by propagating glasses or hand-glasses. It is possible, by means of these, to maintain a constantly humid atmosphere; but, on the other hand, this is not congenial to the stems and foliage of some plants, and accordingly there is danger of the cuttings damping off. It would, therefore, be desirable that moisture should be regulated like heat; but it is more difficult to do. When the earth, sand, or other substance, in which the cuttings are inserted, is kept moist, and a bell-glass pressed closely down upon it, the bottom heat will raise vapour, to keep the air within the glass in a saturated state, and whilst that is the case, evaporation from the surface of the leaves cannot take place. If the glass were raised, of course the vapour would escape, and the cuttings would be too suddenly exposed from a close to a free atmosphere. It would be desirable to reduce the amount of vapour within the glass by gentler means if possible. With this object in view, it will be necessary to take into consideration how the moisture of the air within the bell-glasses can be affected by the external temperature without moving them, presuming the propagation to be carried on in a frame, pit, or other glass structure. Supposing the air under the bell-glass to be completely saturated with moisture, then, 1st. When the air outside the bell-glass is colder than the air inside, the internal moisture will be condensed on the sides of the glass, and being thus abstracted from the internal air, of course the latter will be rendered so much drier. 2d. When the air outside the glass is warmer than the air inside, some condensation may take place outside, but none inside. 3d. When the temperature, both outside and inside the bell-glass, is the same, no condensation either on the outside or inside will appear. Now, if the atmosphere in which the cuttings are placed be too much saturated with moisture, so that the foliage, from being constantly moist, is in danger of damping off, the sashes may be so far opened as to cool the air of the house, or frame, to a little below the temperature of the air within the bell-glasses, or till the moisture is seen to be condensed on their insides. This will have the effect of relieving, for a time, the foliage of its load of moisture; and thus one of the principal causes of damping off may be re-

moved. The moisture will remain condensed on the inside of the bell-glass, or, if abundant, part of it will trickle down the sides of the glass into the substance in which the cuttings are inserted. The water thus distilled will again moisten the air, but, until the latter be saturated, the leaves will be enabled to exhale as much as will tend to keep them healthy. The air, by this means, will not be rendered so dry as to cause the leaves to wither, nor so moist as to prevent exhalation. By the latter, the gorged tissue will be enabled to discharge the superabundant moisture, and with it gases which water has the power of absorbing.

Light.—The importance of this agent of vegetation has been already pointed out. But as cuttings, with their buds and foliage, the parts acted upon by light, are not in the same condition after being severed from the rooted plant as they were before, some remarks become necessary. Without light, buds cannot expand into a healthy green foliage, and without the latter, roots cannot be formed, except in some cases where they may be derived from matter stored in the vessels, and, some time or other, elaborated by the leaves, through the agency of light. It decomposes the carbonic acid held in weak solution, in the crude sap, and effects other important changes. It is, therefore, an agent of great power and activity; but, as such, it is evident that it must have substance to act upon. This is afforded by the roots when they are in communication with the leaves; but when the latter are deprived of that supply, the light requires to be moderated by judicious shading, otherwise its action would have an exhausting effect. All cuttings should, however, have as much light as they can well bear, and some will bear much more than others; thus, scarlet pelargoniums will strike well if exposed to the direct rays of the sun, and so will many other plants of a succulent nature. But there are many plants that will not bear that treatment, and must either be kept entirely shaded from the solar rays, or these must be only partially admitted through a screen. As the cuttings become rooted, light may be more freely admitted.

Bell-glasses.—These are of various forms and sizes. The form should be such as to allow the condensed water to run down the sides, instead of dropping on the foliage of the cutting. Consistent with this, the lower they are the better, provided there is room for the cutting to grow till rooted; for there is an

advantage in having the leaves near the glass. Different coloured glasses have been employed in France; according to Neumann, blue and violet coloured are preferred; but, in the climate of Britain, the light is less powerful than at Paris, and white glass is considered the best.

Pots.—The usual forms of pots, well drained, are extensively employed for the purpose of striking cuttings. Those of which the width exceeds the depth are usually preferred; and round or square pans are also well adapted for the purpose, where bell-glasses are not required. M. Neumann's pot is much approved of by propagators; it is $2\frac{1}{4}$ to $3\frac{1}{2}$ inches wide, and $2\frac{1}{4}$ to $2\frac{1}{2}$ inches high. The hole in the bottom is not covered in the usual way, but a small pot is inverted over it; the bottom of this is level with the surface of the soil, or other material, in which the cuttings are inserted. The small inverted pot receives the heat which ascends through the hole in the bottom of the outer pot, and thus a warmth favourable to vegetation is maintained in the materials surrounding the inverted pot, around which the cuttings are inserted. Instead of inverting an inner pot, as in the above arrangement, Mr. Forsyth employs it as a reservoir for water. The hole in the bottom being closed, it is placed on drainage within a larger pot, so that the mouths of both may be on the same level. The space between the sides of the outer and inner pot is filled with the proper soil, and the cuttings are inserted with their ends touching the side of the inner pot, which is then filled with water. The water percolates slowly through the porous earthenware material, and affords a steady supply of moisture to the cuttings, without danger of saturation.

VIII.—PROPAGATION BY LEAVES.

The first attempt, on record, to raise a tree from a leaf, was made by Mandirola, an Italian horticulturist, whose mode of proceeding was published by Richard Bradley, in the beginning of the last century. This mode of propagation is now advantageously practised with such plants as the gloxinia, gesnera, echeveria, &c.

Roots and buds, it has already been stated, derive their origin and their rudimentary substance, either directly or indirectly, from the leaves. This being the case, it might be possible to propagate most plants by their leaves,

provided the latter could be kept alive, after being detached from the stem, such length of time as would allow of a sufficient quantity of cellular tissue being elaborated and protruded from the petiole, or from the section of the midrib, to form granulated callosities for the production of spongioles and adventitious buds. The leaves of some plants, whilst not detached, return this abundantly to the roots by the natural processes of digestion and continuous supply. The crude sap, which leaves are capable of containing, is in some quickly elaborated, and as quickly replaced; so that, although all the sap which such leaves contain at any instant, may afford but a very small quantity of matter available for the formation of roots, yet, when the supply is continuous, the amount may be very considerable in the course of several weeks. If a piece of clean paper were dipped in a solution of salt and water, and then exposed to evaporation in the sun and air, the quantity of salt left on the paper would be imperceptible to the naked eye; but let a supply of the solution be repeated as evaporation proceeds, and ultimately an incrustation of salt will be formed on the paper. Somewhat similar must be the case with some kinds of leaves; they may be full of sap when detached, but this, when elaborated and returned to the section of the petiole, would not be in quantity to form a callosity. The selection of leaves intended for striking, is of importance. Such as are either too young, or too old, are not proper. The energy of young leaves is employed towards their own growth. Mr. Knight, in his *Physiological Papers*, p. 34, states, that "young leaves expend, in adding to their own bulk, that which ought to be expended in the creation of shoots." On the other hand, leaves that are too old may be considered to have performed their functions, or nearly so, and therefore on the eve of becoming inactive, or of entering into a state of decay. Leaves that are very nearly full-grown are to be preferred; such will generally be found in the middle part of the shoot. Some recommend the petiole to be inserted its whole length. M. Neumann cuts it off, nearly close to the base of the leaf. The foot-stalk, or whatever part of it is left, should be inserted, up to the base of the leaf, in pure white sand, laid over sandy peat, or other compost suitable for the growth of the plant, after the leaf has struck root. When the

foot-stalk is cut off close to the base of the leaf, the latter should be laid on its back, and the base part slightly inserted in the sand, in which it should be kept by a small peg; or a small stone may be placed upon it. The leaves, thus placed in contact with moist sand, should be covered with a bell-glass, the edges of which ought to be well pressed into the sand. They should then be placed in a greater bottom heat than is required for cuttings of the same kind of plant. The glasses must be shaded at first, and although the atmosphere within the bell-glass should be moist, yet it ought not to be too much so. If the leaves are in a state to absorb moisture from the sand, it will, in that case, prove beneficial to allow the air within the bell-glass to be occasionally a little below the point of saturation; or, in other words, it may, at times, possess a very slight degree of dryness. Instead of a bud being formed from a callus of tissue at the section of the petiole, or the midrib, &c., buds are, in some cases, emitted from the indentations of the margin, as in *Bryophyllum calycinum*.

IX.—PROPAGATION BY ROOTS.

All plants that readily throw up suckers from the roots themselves, as the hawthorn, poplar, elm, plum, &c., may easily be propagated by cuttings of the roots. Although the normal formation of buds giving rise to shoots is in the axils of the leaves, yet buds frequently appear on parts where no leaf ever existed. These are termed *adventitious buds*. If healthy, vigorous roots of, for instance, the common hawthorn, are taken up, chopped into short pieces, scattered on the surface of a piece of raked, dug ground, and then covered with soil, they will push shoots, and strike root. Plants raised by cuttings of the roots will form a hedge sooner, by several years, than those raised from seed. Although cuttings of the roots of the above plants will strike when laid horizontally, yet it is better to plant them in an upright position, with their tops level with the surface, or only covered with the slightest possible quantity of soil. The cuttings may be from 3 to 9 inches in length; and in planting, care should be taken that the end of the cutting which was nearest the stem be placed uppermost.

Neumann remarks of the *Cydonia japonica*, that it is propagated much more slowly by

layers than by cuttings of the roots. He says, that if the roots of this plant are cut, when as thick as a quill, into pieces of from 2 to 2½ inches long, and planted upright, as many plants will be obtained in the same year as there were pieces planted. The cuttings should be planted in a peat border, in the open air. If placed vertically, they should be covered very slightly with earth; if horizontally, the covering should be about the ⅓rd of an inch thick. The latter method succeeds very well, but the upright mode is more certain. The whitethorn, plum, apple, pear, quince, rose, robinia, poplar, elm, mulberry, and maclura, are some amongst the many trees which may be propagated by roots. Many herbaceous plants, as the horse-radish, sea-kale, anemone japonica, &c., may also be increased in the same way. Some coniferous plants are difficult to strike from branches, or if they do, are apt to retain the character of branches; but by root cuttings, shoots that have the true character of stems are produced. It may be mentioned, that a plant raised from a root cutting, bears leaves, flowers, and fruit exactly similar to those of the original tree. For instance, trees have been reared from the roots of the Ribston pippin, and they possessed all the excellent qualities of that well-known sort.

X.—PROPAGATION BY GRAFTING.

Grafting is an operation in which two cut surfaces of the same plant, or of different plants, are placed so as to unite and grow together. The cutting, or portion cut off, is termed the *scion*, or *graft*, and the rooted plant, on which it is placed or *worked*, is called the *stock*.

The art of grafting is of great antiquity, but by whom it was invented is not known. It was spoken of by Theophrastus, Aristotle, Varro, Pliny the naturalist, Virgil, Agricola, and other ancient authors. It would appear, however, from their writings, that the principles were very imperfectly understood, otherwise they would not have entertained the belief that the vine could be grafted on the walnut or cherry, and the peach on the willow; or that black roses would be the result of grafting on the black currant; for these plants, having no natural affinity, can never form a vital union, however accurately they may be mechanically joined.

The modes of grafting are exceedingly numerous, but they all depend upon one principle, which should be well understood. But previous to explaining that, it must be remarked, that wood does not unite with wood so as to form a vital union; for, after trees have been grafted for many years, it is found on dissection, that between the portions of the wood of the scion and stock, which were placed together at the time of grafting, no union has ever taken place. When all the wood subsequently formed is removed, the parts previously formed can be readily separated, exhibiting two clean cut surfaces, or, occasionally, with a little dead cellular substance interposed; it is therefore evident, that the pieces of wood already formed do not unite, however accurately they may be joined.

If a tree is cut horizontally through in autumn, or before the sap rises in spring, and if the section be covered over with grafting clay, or other material, so as to protect it from the drying effects of the air, it will be found that, in the course of the season, a protrusion of tissue will take place all round, from between the wood and inner bark. Sap may exude from the woody part of the section, but that sap produces no organized tissue; when exposed to the air, it evaporates, and its residuum, if any, is dead matter. Additional organized substance is only formed, as above stated, at the circular line which traces the limits between the wood and inner bark. There, it may be frequently observed, projecting above the level of the section of the stem, and thus rendering evident the seat of organization where nascent tissues readily unite, when brought in contact with similar tissues in a young and active state. This constitutes the fundamental principle of grafting.

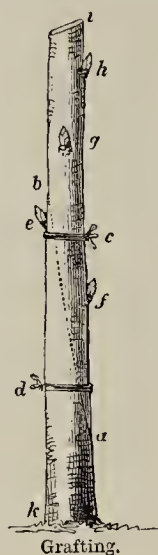
With regard to the cutting intended for the scion, if it is cut off whilst its buds are but little expanded, and its lower end be inserted in the earth, cellular substance will protrude from that end, as the warmth of the season expands the sap, stimulates the buds, and excites the vital action of the tissues.

Now, if the cellular substance thrown up from the cross-cut stem, and that thrown down by the cutting, could meet each other before the air formed a sort of skin on their respective surfaces, they would coalesce and unite. Such a union, however, would be very insecure, for it is difficult to fix firmly together two pieces of any substance, end to end. The

scion, in this case, would derive no mechanical support from the stock to keep it in an upright position; and it would be very liable to be displaced before the cellular substance above mentioned, could acquire a sufficiently woody nature to enable it to resist the slightest disturbing force.

If, in the young stem, represented by Fig. 167, the edge of a sharp knife be entered at

Fig. 167.



a, and, with one straight sloping cut, brought out at *b*; and if the parts be again joined exactly, ties at *c* and *d* will hold them together so that they would not be readily displaced. The sap, interrupted by the section *a b*, will not accumulate at *i*, but will pass along by the inner bark of the section between *a* and *b*, and will there meet with the tissue descending from the upper part *a b i*, which may be termed the scion. Presuming that the parts are very exactly fitted, a most perfect example of grafting will be obtained; like parts will be everywhere joined to like, and

the whole will be in the best possible position for uniting; the outer barks will coincide perfectly, so will the *inner barks*, and every part of the wood will be brought in contact with its counterpart. It is not, however, on the junction of the outer barks, nor on that of the woods, however exact, that the success of the operation is attributable, but it is on the junction of the inner barks that union depends. This is the leading principle in all the modes of grafting, and they may be infinitely varied, provided that principle be kept in view. Strictly speaking, the vital union is not effected by the contact of the portions of inner bark, for it, like the outer bark, is a part already *formed*, whereas the union takes place in consequence of the contact of tissues that are in a *forming* state; such tissues are formed by the cells of the cambium, which lies between the surface of the alburnum and the inner bark; but the latter is a convenient term to use, because it is generally known; and if two portions of inner bark be joined edge to edge, the substance immediately below them will also be in contact. If we take a piece of clean grown willow branch, when the sap is in motion, in spring, and beat it a little, an entire cylinder

of bark may easily be taken from the wood, the latter exhibiting a smooth, slippery surface, as if it had been rubbed with tallow or thin gum. The inside of the cylinder of bark will be found coated with a similar substance. If we take a piece of older wood, with bark as much as $\frac{1}{2}$ inch thick, dead, rugged, and corky on the outside, yet, on removal, the internal surface of the wood beneath it will be found smooth, and lubricated with the organizing sap. It is the place where this forms a thin semifluid layer that should be joined in grafting, and this will be the case if the inner barks are placed in contact. We have supposed Fig. 167 to represent a plant divided by the middle; but let us now suppose that the stock *k a b* is a quince, and that the scion *a b i* is a pear shoot well joined. If so, all other circumstances being favourable, a union will take place, and the pear shoot will grow into a tree, fed by the roots of the quince; whilst the latter will add to its bulk by means of sap elaborated by the leaves of the pear. But, whilst this takes place, whatever wood is added to the quince side of the line *a b*, will be quince, and that on the pear side of the same line, will be pear. If the bud *e* should be allowed to push, it would produce a quince shoot, although the stem opposite to it chiefly consists of pear wood; and, on the contrary, the bud *f* would give rise to a pear shoot, although backed by quince wood. The stock may modify the graft, just as different soils will modify the growth of plants that derive their nourishment from them; and so the stock does not otherwise essentially alter the nature of the tree grafted upon it. There is a common communication of fluids between the vessels formed above and below the line *a b*, but the pear and quince form their own peculiar secretions from the same common source. Wherever there is quince bark in a healthy state, under it quince wood alone will be formed; and wherever there is pear bark, pear wood only will be produced. The elaborated sap, from leaves on shoots pushed by the buds *g h*, does not, in its descent, form a layer of pear wood from *b* to *k* over the quince, although M. Gaudichaud, and others, were of opinion, that wood was an assemblage of the roots of buds extending from the latter to the extremities of the roots. A more correct view of the subject is taken in an article by M. Trécul, in the *Revue Horticole*, of which a translation is given in the *Gardeners'*

Chronicle, 1853, p. 788. He says, "In discussing the experiments of M. Gaudichaud, I have given the following as some of the facts which are apparently the most favourable to the theory of radical fibres descending from the leaves. A poplar root was uncovered at the middle, and cut completely across, so that neither the wood nor the bark of the two parts remained in any way connected. The cut surfaces were brought together and maintained in close contact, with collars; they were then surrounded with moss, and covered over with earth. The two halves of the root united. According to the partizans of this theory, the two parts of the root unite by the radical filaments which descend from the leaves, and these, they say, having come in contact with the lower part of the root, penetrate between its wood and bark, thus continuing their downward course. According to my observations, the phenomenon takes place in quite another manner. Although I have not myself made the experiment, which I am only acquainted with by means of the parts sent to me by M. Gaudichaud, yet I believe that a satisfactory explanation can be given, one founded on the principles laid down in my different memoirs, and on what occurs during the taking of the graft. A swelling of cellular tissue is produced round each of the two sections, by the cells of the cambium (*couche génératrice*); the swelling of the upper portion of the root is larger than that of the lower, but that is of no importance. When the two sections come in contact, the nascent tissues unite all round the root, or on a part only of its circumference. This union, by means of the protruded tissue, consolidates by the formation of fibro-vascular elements in the interior of the aforesaid tissue. These fibro-vascular elements are developed in this tissue, in the same way as they are in that which, first of all, constitutes the excrescences on the surface of the alburnum when it has been barked. In the same manner, on this swelling, a bark is formed, which covers the young ligneous layer. From that time, vegetation goes on as usual. Still, however, more wood is produced at this point than elsewhere, because the primitive accumulation presents an obstacle to the flow of the nourishing fluids contained in the descending sap, which passes from cell to cell, and not between the wood and bark, as it was once generally supposed to do. The partial stoppage of the juices at this point also causes the fresh layer of alburnum

to be thicker above than below the graft. A graft bears the same relation to its stock as an adventitious shoot to the plant on which it grows. When the parts have once united by means of the cellular tissue, and when the first fibro-vascular elements have been formed, there is perfect continuity between the wood and the cambium, or between the inner bark of the stock and those of the graft. All the other anatomical phenomena are also the same, for although the nature of the stock is not modified by the graft, the vascular filaments (called erroneously radical fibres) or vessels, for they are nothing else, do not the less appear to descend from the graft to the stock, in the same way as they seem to descend from the adventitious shoot to the stem that bears it. This is in both cases merely an appearance, because cellular multiplication is always carried on horizontally, and because it is the cellules which result from this horizontal multiplication, which change some into vessels and others into woody fibres and medullary rays.

"Like the adventitious shoot, the graft draws nutriment from the wood of the stock; it elaborates it in its leaves, and returns it principally by its inner bark to the lower part of the plant. In descending from cell to cell, the juices leave part of their assimilable substance; each cellule appropriates what is best adapted to its nature. This is the reason why the nature of the stock is no more modified by the juices which descend from the graft, than the latter is by the juices which it derives from the stock. The cells nourished in this manner produce, by their division in a horizontal direction, cells of the same nature as themselves, which are modified according to the functions they are called on to fulfil."

Affinity between Graft and Stock.—However well the operation of grafting may be performed, and that in accordance with the principles already explained, yet the results will be unsuccessful unless the stock and scion are nearly related, such as varieties of the same species, species of the same genus, or genera of the same natural order, beyond which the power does not extend. The pear will succeed on the pear, quince, hawthorn, mountain ash, and medlar; but it can scarcely be said to do so on the apple, although it is less dissimilar in appearance than some of those above mentioned, and which have, in fact, a greater generic difference. The peach and nectarine succeed on the almond, a species of the same

genus, and also on the plum, a different genus. Much as is practically known with regard to the species and varieties that will agree with each other when grafted, yet there is much which can only be learned by experience. For instance, some kinds of pears do not succeed well on the quince, and it is only after trial that such as do, and such as do not, can be distinguished.

Modifying influence of the Stock upon the Graft.—This chiefly arises from the stock supplying the graft with a greater or a less amount of nourishment than it would receive from its natural root, and, consequently, producing a more or less vigorous growth. It is, however, to be remarked, that if a weak growing variety is worked on a stock that is comparatively too vigorous, a strong growth may be induced in the first instance; but, in such cases, a disparity in the rate of increase in the size of the stems checks the free circulation of the sap at the point of junction, and the tree is apt, ultimately, to become stunted. In short, too great a disparity in the nature of the graft and stock should be avoided, if a steady growth be considered desirable. When the nature of the stock is such that its stem increases in diameter quicker than that of the stock, the latter usually grows more vigorously than on its own root; but, as the swelling increases at the junction beyond certain limits, the flow of sap is checked, and a degree of vigour annually decreasing, is the consequence. When, on the contrary, the stem of the stock is naturally of slower growth than that of the kind worked upon it, a dwarfing effect is the immediate result. Such, for instance, is the case when a variety of the apple is worked on the French paradise.

The hardiness of the stock is of great importance in the cultivation of trees and shrubs indigenous to southern climates, for many of such plants either perish or thrive badly on their own roots, when planted in the comparatively cold soil of Britain. They are, of course, affected somewhat injuriously by the coldness of our atmosphere, but they are more than doubly so when the roots, upon which their supply of nourishment depends, are also in a colder medium than they are adapted to endure. But when grafted on a stock, the roots of which are not likely to be injured, in a properly drained soil, by the lowest ground temperature which occurs in this country, tender plants, that can be properly grafted on such,

thrive tolerably, in consequence of being fed by roots uninjured by cold.

In many cases, the stock can be suited to the nature and condition of the soil and subsoil. The pear, for instance, sends down strong roots to a great depth; and in a wet subsoil, where they would be in a constantly saturated medium, they would perish. The quince roots, on the contrary, extend near the surface, and thus avoid the too wet subsoil; besides, the quince likes to be near water, and it will thrive in low situations that are liable to be occasionally flooded. Under these circumstances, pears on their own roots would not thrive, and recourse must be had to grafting on the quince stock.

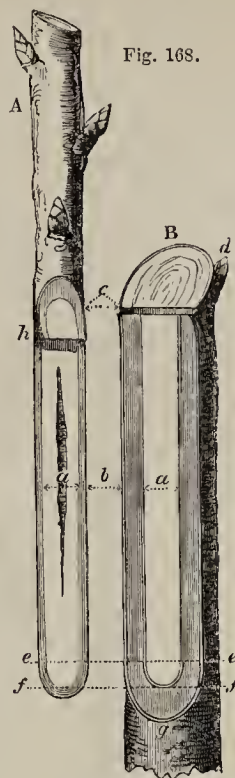
Grafting may be employed with great advantage in bringing trees and shrubs sooner into a flowering and fruiting state, than would be the case on their own roots. Many kinds of trees, if in that healthy vigorous state which they ought to be, do not commence bearing till they have attained almost their natural height, and have formed a stem and branches of considerable thickness, and then, from these thick branches others which bear fruit proceed. A young plant might be twenty years before it formed a stem to support limbs, and these again, branches or spurs for fruit. But by taking such young plant and grafting it on a tree, having a bulk of stem and branches already formed, it is at once placed in the same condition as if it had been allowed to grow to that bulk of wood itself, that, however, requiring the lapse of many years.

By grafting a young shoot of a seedling tree on a part of another tree, furnished with fruit-buds, the disposition of the young shoot to produce wood shoots only is modified; and it soon acquires the condition of the branch on which it is grafted, and early bearing is induced.

MODES OF GRAFTING.

1. *Whip-grafting, Splice-grafting, or Tongue-grafting*, is, on the whole, the best mode of grafting, and the one most extensively employed in this country. It is represented by Fig. 168, where A is the scion, B the stock. In each, a cut surface is exhibited, showing the wood *aa*. The points, at the extremities of the dotted line, *a* and *a'*, touch the inner barks of both stock and scion, whilst the points at *b* touch the outer barks. It will be readily observed that the bark of the stock, because

older, is thicker than that of the scion; consequently, if, as ought to be the case, equal



Whip-grafting.

surfaces of wood are exposed, the cut surface of the scion would not completely cover that of the stock, nor would this ever be the case, except when the barks of both stock and scion are of equal thickness. In proceeding to operate, cut the top of the stock in a sloping direction from *c* towards *d*, terminating, if possible, above a bud, developed or latent, as at *d*. Then take the scion and cut it sloping from above *c*, and thin towards the end at *f*; next enter the knife at *h*, and cut a thin tongue upwards to *c*. The scion is now prepared. Then, proceeding to the stock, enter the knife at *g*, and cut a slice upwards to *c*,

so that the surface of the wood shall be, as nearly as possible, a counter-part of the exposed surface of the wood of the scion. If this should happen to be the case by a single cut, so much the better, but if not, it should rather be too narrow than too wide; for, in that case, a shaving can be taken off till the cut face *a* of the stock equals that of the scion. Enter the knife very little below *c*, and cut a notch to receive the tongue of the scion; this notch should be kept open with the point of the knife, whilst the tongue of the scion is being inserted; the inner bark, indicated by the points at the ends of the dotted lines *aa* of the scion and stock, should be placed in contact, the parts secured by tying with matting or other material, and surrounded with clay, grafting wax, or other substances, to exclude the air and wet.

In operating as above detailed, the principle to be kept in view is the coincidence of the inner bark of the stock and scion. This being understood, some explanatory remarks may now be made, to prevent mistakes that might otherwise occur.

In the first place, it will be observed, that the head of the stock is cut off sloping, and, that the slice is taken off for the scion on the

side where the slope is lowest, as at *c*. This is done in order that the wood may be sound behind the graft, after allowing for a portion dying back, which is generally the case, more or less. If the scion were placed on the side *d*, then, after a portion of the top had died back, the graft would have little but dead wood behind it, and there would, consequently, be a weakness at that part. The slope is made to terminate above the eye at *d*, and to this it may die back, but not likely farther. Indeed, the eye will be apt to push, but if it do so, it must be checked. Some recommend the notch for the tongue to be made half way down the cut surfaces of the scion and stock, as at *a*, but it is better to be very near the top, as represented; for, by making the incision at *a*, the flow of sap would be there interrupted, and, in a great measure, cut off from supplying the part between *a* and *c*. Care should be taken that not the least portion of the wood of the scion at *e* extend below the wood of the stock at the same point; for if it do, the consequences would be as follow:—Supposing that the termination of the wood of the scion at *e* were placed as far down as *f* on the stock, then, when vegetation took place, and the returning sap of the scion reached the oblique end section of the inner bark, it could meet with no corresponding vessels to receive it; for the sliced bark of the stock, on which the sap from the end of the scion exudes, could not unite; accordingly, a mass of cellular tissue would collect, become woody, and form a knob, which, as it increased, would raise an unsightly projection, instead of a smooth junction, at the end of the scion. It is better that the point *e* of the scion should scarcely extend so far as *e* on the stock, than that it should, to any extent, exceed it.

It is well to have a bud at the back of the cut face of the scion, near the lower part, as at *f*, Fig. 167; for it sometimes happens that the scion is broken by wind, or otherwise accidentally injured, and, in that case, the only chance of saving the graft is by encouraging the bud *f* to push. In making the sloping cut on the scion, it is advisable to enter the knife below a bud; for that bud will contribute to the healing of the wound in its vicinity.

The scion having been fitted as accurately as possible to the stock, keeping in view the coincidence of the inner barks, the next proceeding is to secure the parts in their proper position. A strip of matting is generally em-

ployed for this purpose. Take the strip near the end, and place it so as to catch across the lower extremity of the scion. Pass the long end of the tie from the left hand to the right, and, at the same time, the short end from the right to the left hand, making the tie cross over the short end, so as to prevent it from slipping. Continue to wind the strip of matting closely round, till it reach the top of the stock; then make one or two turns downwards, drawing the end under the last turn, in order that the tying may not unroll.

The final operation is to defend the graft from the drying influence of the air by some sort of covering, usually grafting clay, or grafting wax; some preferring the one, and some the other. We shall suppose that grafting clay is to be employed. In that case, take a little of it and rub it over the matting, squeezing it on rather closely, so that it may not readily part; then take a ball of the clay, larger or smaller, according to the size of the parts grafted, and put it round, tapering the ball at top and bottom, like an oblong spheroid. Some dry sand, or sifted coal ashes, taken between the hands and daubed over the clay, will render it easier to press the whole into form, and will tend to prevent cracking. In working stocks near the ground, the soil, in many instances, can be drawn up over the graft. This preserves the moisture in the clay, and, consequently, prevents the scion from being dried up before it unites, so as to derive sap from the stock. In this way, success is often insured where it would otherwise be precarious. In particular cases, the clay round the graft should be covered with moss, the latter being secured with matting, and kept moist, in dry weather, by frequent watering through a tolerably fine rose; and although it get dry at intervals, that is immaterial, provided that water is always supplied before the ball of clay becomes completely dry.

The scion usually pushes but slowly for some considerable time after it has been grafted; and whilst that is the case, there is little danger of the ligature becoming too tight. But when fairly united, the scion frequently makes rapid growth; and due precaution must be taken to prevent it from being galled in consequence of the ligature not giving way to the increasing thickness of the stock and scion. Before there is danger of this, the clay must be removed, and the tie loosened. The clay is best removed after it has been softened by

rain, and, if possible, the opportunity should be taken when it is in that state. If there should be no such opportunity, and if the untying cannot be delayed, the clay ought to be moistened through the rose of a watering pot. The ball can then be readily broken off by holding a brick against the one side, whilst the opposite one is struck a smart tap with a hammer. It is frequently advisable to retie the graft rather slightly; for the tissue at the junction will scarcely be adapted for withstanding exposure, and it will not have formed woody fibre enough to resist the action of the wind. In particular cases, or where the union is found to be yet imperfect, it will be well to put on a little clay after retying the graft. When the ligature employed in binding the scion and stock together is finally removed, the graft is sometimes in danger of being broken off by the wind. In order to guard against this, a rod should be made secure to the stock, opposite to the graft, and to this rod the latter should be tied. In August the heel, or slanted extremity of the stock, behind the graft, should be neatly pared off; and if the graft is vigorous, and the stock not very thick, the wound will heal over before winter. Any suckers or shoots that appear below the graft should be cut clean off.

Saddle-grafting.—This is represented by Fig. 169. It cannot be well performed except when the stock and scion are of nearly equal thickness. The stock A is cut sloping on both sides, like a wedge, terminating at c. The scion B is split up the centre, and each half is thinned to make it fit astride the wedge-like end of the stock. A thin narrow-bladed knife should be employed for this purpose. The inner bark of the scion and stock having been made to coincide as nearly as possible, the parts should be secured by a ligature, and covered with some grafting composition.



Fig. 169.

Saddle-grafting.

grafting; and, as already observed, it cannot be well employed unless the stock is nearly of the same size as the scion; for, supposing the stock to be $\frac{3}{4}$ inch in diameter, and the scion only $\frac{1}{4}$ inch, the inner bark might be joined at the lower part, but could not possibly be so at the thinned edge at the top of the stock; on the contrary, $\frac{1}{2}$ inch of the wood must be there uncovered by the scion.

Cleft-grafting (Fig. 170) is a common mode in some parts of the country, but it is, nevertheless, a very objectionable one.

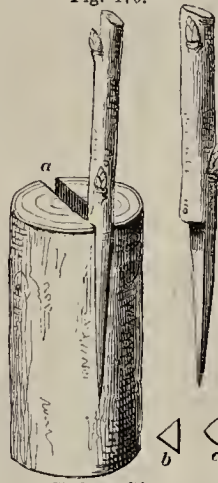


Fig. 170.

Cleft-grafting.

The stock is cleft with a chisel, or other instrument, at a; and the cleft is kept open till the scion is inserted. The scion is cut wedge-shaped, and inserted in the cleft, so that the inner barks may coincide. It is then covered with one or other of the grafting compositions, generally grafting clay when the stock is large.

In preparing the scion for insertion, it is cut tapering towards the lower end, and made thin at the side intended to be placed towards the interior of the stock. There should be no bark left upon the inserted part of the scion, except that on the outside; for, if any were left on the opposite or interior part, the sap descending by the inner bark of that part would find no substance with which it could unite. When the stock is thick, and requires considerable force to keep the cleft open, it is apt to pinch and bruise the inner bark of the scion, next the outside, if it is thinned with a straight slope from the back to the edge; for, in that case, the whole of the pressure would be upon the part next the bark. The section of the scion should not be like a triangle, b (Fig. 170), but like half an oval, c.

Occasionally, when a large stem or limb is cleft-grafted, two scions are inserted, one as represented in Fig. 170, and another opposite to it, in the end of the cleft next to a. In some cases the stock has been cleft across, and again transversely, so that four scions might be inserted. But cleft-grafting is a bad mode. It will be observed that there is an opening which extends from the insertion of the scion to the opposite side of the stock at a. This rent in the solid wood can never heal so as to

be again solid. Should there be another scion introduced at *a*, the two scions would contribute to produce new wood to heal over the top of the stock, and the chasm would be lessened, but not closed in the middle. On the Continent, in cleft-grafting with one scion, the stock is frequently cut sloping, as at *a* (Fig. 171), a small shoulder being left at the summit, where a cleft is made and the scion inserted. This mode does away with much of the projection which otherwise exists, as at *a* (Fig. 170), and renders the stem more tapering at the graft; but it is still objectionable, as it leaves a rent or blemish behind the graft. Instead of splitting the stock, it would be better to cut out a triangular groove in the

Fig. 171.



Fig. 172.



Fig. 173.



Fig. 171. Cleft-grafting. Fig. 172. Triangular Notch-grafting.
Fig. 173. Crown or Rind Grafting.

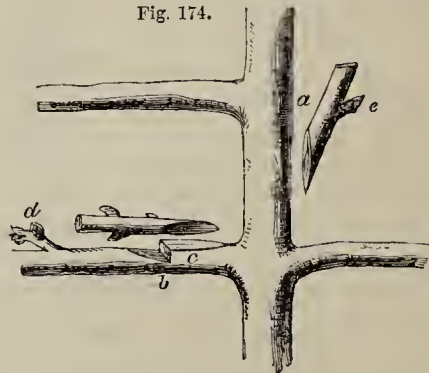
side, and in that fit the scion, so that the inner barks might correspond, as in Fig. 172.

Crown or Rind Grafting (Fig. 173) is much to be preferred to cleft-grafting, inasmuch as the wood of the stock is not rendered unsound by cleaving. It is easily performed; the lower end of the scion is cut sloping, as in whip-grafting; the head of the stock is cut over horizontally, and a slit *a* is made just through the inner bark. A piece of wood, bone, or ivory, in shape somewhat resembling the thinned end of the scion, is introduced at the top of the slit, between the alburnum and inner bark, and pushed down, in order to raise the bark, so that the thinned end of the scion may be introduced without being bruised. The edges of the bark, on each side, are then brought close to the scion, and the whole is bound with matting, and clayed. When the stock is large, in order that its top may be soon healed over, and in case of a single graft, *a*, failing, two others are introduced at *b* and

c. It is to be observed, that although the scion may be pared flat on the side intended to be placed next the wood of the stock, yet the latter being circular, the flat cut face of the scion can only be in part closely applied to it; for a perfectly flat surface can only touch the circumference of a cylinder longitudinally along one line. Therefore, if the central portion of the flat cut face of the scion touch the wood of the stock, or layer of cambium, the edges of the inner bark can scarcely do so, and the organizing cellular substance of the stock must accumulate towards the edges of the scion before it can reach its inner bark. Instead of the scion being made flat, it would better accord with the principles of grafting if its wood were made slightly hollow, so that its inner bark might be in immediate contact with the layer of cambium from which the bark of the stock was raised. If this cannot be done, care should be taken that the scion be at least cut flat, and by no means with convexities. The raised bark is of no use, beyond affording some security and protection for the scion. Part of it dies; and by affording a lurking-place for insects, and collecting moisture, induces decay in the tree. On the whole, crown-grafting is not so good as whip-grafting; and, generally, the latter proves the superior mode of the two, when tried under similar circumstances. Even when the stock is of large size, as much as 3 or 4 inches in diameter, whip-grafting answers well.

Side-grafting.—This is a modification of whip-grafting, and is performed in the same manner, except that the stem or branch, instead of being cut completely off, is notched to a greater or less depth, according to circumstances, as at *b* (Fig. 174). It is useful

Fig. 174.



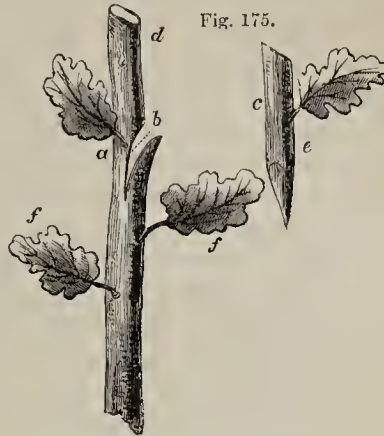
Side-grafting.

for supplying a branch, where one is deficient, on an upright stem, as at *a*; and for replacing

the branches of a tree with others of a different sort, the original being allowed to remain till the grafts extend so as to nearly occupy their place. With this object in view, a notch is made near the stem, on the upper part of the branch, as at *b*, and a slice is taken off between the notch and the stem, as at *c*. The graft is placed there; when it pushes, the shoot must be trained horizontally; and, as it extends, any growths or spurs that are in its way, as at *d*, should be cleared off. In the case of fruit-trees, the original branch, notched in this way, bears as well as if no such operation had been performed, and sometimes even better. When the new branch has grown to a considerable extent, the original should be entirely cut off at *b*. In supplying a branch, as at *a*, the scion must be placed with a bud pointing outwards, and the shoot proceeding from it trained in a horizontal direction towards *e*.

Herbaceous Grafting, as its name implies, is applicable to plants, or parts of plants, that are in an herbaceous state. It was brought into notice by the Baron de Tschudy, about the year 1815. It has been successfully practised in grafting the melon on the cucumber, the cauliflower on the borecole, the tomato on the potato; and Dr. Maclean, of Colchester, grafted the white Silesian beet and the red beet on each other. Dwarf species of cactus are very commonly grafted on tall ones; and walnuts, resinous trees, and others, which are difficult to unite by the ordinary modes, may be successfully grafted by employing parts that are still in a growing and almost herbaceous state. The time for the operation is when both the stock and the tree from which the scion is taken are in full growth, and when the shoots have commenced to acquire a somewhat woody consistence at some distance below their extremities; and the place to operate is where this is found to be the case. M. Du Breuil recommends making an oblique incision, *b* (Fig. 175), as close as possible to the base of the petiole of the leaf *a*, merely saving the bud in the axil. Into this incision, the scion *c*, of the same diameter, and in the same state of growth as the stock, is fitted. The graft is then tied with coarse worsted. The leaf *a* is intended to draw the sap towards that point; whilst the leaf *e*, on the scion, partly absorbs the sap thus obtained. The fifth day after the operation, the central eye in the axil of the leaf *a* is removed. Five days

later, the disks of the leaves *f, f* are cut off, leaving only the midribs; the buds in the axils of these leaves are removed at the same time. About three weeks after the opera-



Herbaceous Grafting.

tion, the disk of the terminal leaf *a* should be cut off. The successive removal of the leaves tends to throw the ascending sap into the scion, and about a month after grafting, the scion will begin to grow; the tying may then be loosened, and a piece of paper wrapped round for ten days.

Herbaceous Grafting of Resinous Trees.—This has been extensively practised in the forest of Fontainebleau and elsewhere in France.



Herbaceous Grafting—
Resinous trees.

The mode of operation, as detailed by Du Breuil (*Cours élémentaire théorique et pratique d'Arboriculture*), is as follows:—

When the terminal shoot of the stock *a* (Fig. 176) has attained about two-thirds of its length, it is cut back with a horizontal cut, to the point where it begins to lose its herbaceous consistence and commences to become woody. The young leaves are cut off between *a* and *d*, a distance of between $2\frac{1}{2}$ and 3 inches, leaving, however, about two pairs at the top *d d*, to attract the sap. Thus prepared, the stock is split down the middle, to the depth of 1 inch, or $1\frac{1}{2}$ inch. The scion *b* is cut wedge-shaped, and introduced into the split, so that the commencement of the cuts on each side of the scion may be nearly an inch below the top of

the stock. The scion should be cut at the place where its consistence is similar to the part of the stock where it is to be inserted. Its diameter ought to be as nearly as possible equal to that of the stock. The graft being placed, it is secured with coarse worsted, commencing the tying at the top and winding it down to the lower part. In the case of delicate species, it is well to wrap paper round the grafted part, as a protection against the drying action of the sun and air. The shoots at *c* are then broken at about $\frac{1}{2}$ inch from their bases. Five or six weeks after grafting, the cuts will be completely healed; the tie may then be removed, and the two portions *d* furnished with leaves at the top of the stock, should be cut off, otherwise they might give rise to buds which, in pushing, would weaken the graft.

Root-grafting.—Many kinds of plants may be increased by root-grafting more quickly than by any other means, when stocks are not in readiness. A few scions worked on the branches of a grown-up tree may soon produce hundreds of shoots; and thus the variety can, in one sense, be increased; but this increase only constitutes a single tree. If, instead of grafting the branches, the tree had been cut down and its roots grafted, then every piece of root upon which the operation had been performed would have formed a distinct plant.

Root-grafting is conducted on the same principle as the grafting of stems and branches, and that having been already explained, need not be here repeated. When vegetation is at rest, the roots ought to be severed from the base of the stem; and if the latter can be entirely removed, so much the better. The cut end of the root should be raised nearly upright, if possible, so that the scion, when put on, may point upwards. The part of the root operated upon must then be washed, or otherwise freed from soil, in order that the wound may be clean. The graft should be tied, and clayed to prevent wet from entering the wound; and the root ought then to be again covered with soil, which should also cover the grafted part, leaving only one or two buds of the scion exposed. When the graft pushes, the ligature must be loosened, as in the case of grafts above ground. In grafting fleshy roots and tubers, such as those of the dahlia and pæony, the stock is cut in a triangular form, and a piece of exactly the same shape is fitted in. The mode is the same as that represented in Fig. 172.

Grafting Clay.—This may consist of two parts clay, or clayey loam, and one part of cow-dung, free from litter; but we have found from experience that some fine, tough, short hay, mixed and beaten up with the clay and cow-dung, is of great utility in preventing the clay from cracking and falling off. In fact, it answers the same purpose as hair in plaster. Some recommend horse-dung to be used instead of cow-dung, others part of both; but cow-dung is best for retaining moisture. It is not absolutely necessary that the above proportions should be preserved. The French grafting clay consists of a mixture of equal parts of clay, or fresh clayey loam, and cow-dung; this, they term *onguent de St. Fiacre*; and they employ it not only for grafting, but also for covering the wounds of trees. It is advisable to prepare grafting clay several weeks before it is required; in doing so, the clay should be well beaten, the cow-dung ought next to be mixed with it, and the hay may then be added. The whole should be moistened, turned, mixed, and beaten, several times, at intervals of a day or two. It must then be formed into a round heap, and covered to prevent evaporation. A hollow, made in the top of the heap, and filled with water, has the effect of keeping the mass in a moist state.

Grafting Wax.—Various proportions of different substances are used in forming grafting wax.

Daniell Powell, Esq., recommends (*Horticultural Transactions*, vol. v. p. 285) the following ingredients be made use of, viz.:—Pitch, 1 lb.; rosin, 1 lb.; bees'-wax, $\frac{1}{2}$ lb.; hogs' lard, $\frac{1}{4}$ lb.; and turpentine, $\frac{1}{4}$ lb. In the above composition, however, we consider the introduction of turpentine objectionable, as it has an injurious effect upon the buds and tender bark.

A French grafting wax is composed of pitch, 5 parts by weight; rosin, 1 part; yellow wax, 1 part; tallow, 1 part; with as much fine brickdust as will give it consistence.

Du Breuil recommends black pitch, 2 parts; Burgundy pitch, 2 parts; yellow wax, $1\frac{1}{2}$ part; tallow, 1 part; sifted ashes, 1 part.

According to Downing, excellent grafting wax is made of 3 parts bees'-wax, 3 parts rosin, and 2 parts of tallow; but, he adds, that the grafting wax most commonly used in America is made of tallow, bees'-wax, and rosin, in equal parts; or, as many prefer, with a little more tallow to render it pliable. This we prefer to compositions containing so much pitch

as there is in those used by the English and French. The use of grafting wax is to keep out air and moisture; and, provided it does that, the softer it is the better.

It is a question whether grafting clay or wax is the better; some prefer the one, and some the other. In grafting small and delicate plants, clay cannot be well applied, and therefore it becomes necessary to use some kind of grafting wax; but in the case of strong plants, such as fruit-trees, in the open air, clay has some decided advantages. In the first place, clay retains moisture for the benefit of the scion, whilst no moisture can be derived from the grafting wax; and the scion is apt to be dried up before it has time to form a union. A cold, dry state of the weather may ensue after grafting, so that little or no movement of sap, and, consequently, as little progress towards forming a union, can take place. During such periods, the scions are enabled to retain their vitality by absorbing moisture from the clay. Again, it is well known that the bark of trees is not liable to be injured by contact with common earthy substances. It may be covered with such for any length of time, and still retain its freshness; and its expansion is rather promoted than otherwise, a circumstance which is favourable to the flow of sap. Pitchy substances, on the contrary, rank among those which injure tender bark; even if there be nothing specifically injurious in their ingredients, the mere mechanical effects are bad; for expansion is prevented, perspiration is obstructed, and canker is produced.

XI.—PROPAGATION BY BUDDING.

Budding is an operation by which a bud, together with a portion of bark, is removed from a plant, and inserted beneath the inner bark of another plant, or beneath that of the same plant; for this is sometimes done where the natural buds do not push to form shoots at places where these are necessary. As in grafting, only nearly allied species or genera will succeed when budded on each other. The main principle of budding is the same as in grafting. The union is effected by means of the organizable matter, or cambium, which exists between the alburnum and inner bark; and the success of the operation depends upon the abundance of that matter being such as to permit of the bark being easily raised from the wood. When both the stock, and the tree from which

the bud is taken, are in that condition, the union is most readily effected. There are periods when the flow of sap is arrested, and then the bark adheres firmly to the wood, and when that is the case budding should not be attempted. Calm but warm weather is the most favourable; excessively dry weather with strong sun is apt to kill the buds, and wet weather proves injurious to them, unless they can be protected from rain; for, when the latter gets into the wound it decomposes the sap, and organization cannot proceed so as to form a union.

Buds are generally inserted in July or August, in which case they remain dormant, or, at least, do not usually push into shoots till the ensuing spring; this is termed by the French, budding with a dormant eye (*greffe en écusson à œil dormant*), but, occasionally, buds formed in the previous year are inserted in spring, or when they are preparing to grow; this is called budding with a pushing eye (*greffe en écusson à œil poussant*).

The modes of performing the operation are various; the principal are:—shield-budding or T-budding, inverted T-budding, square shield-budding, flute-budding or tube-budding, and annular or ring-budding.

Shield-budding, or T-budding, is represented in Fig. 177, where A represents the stock, and

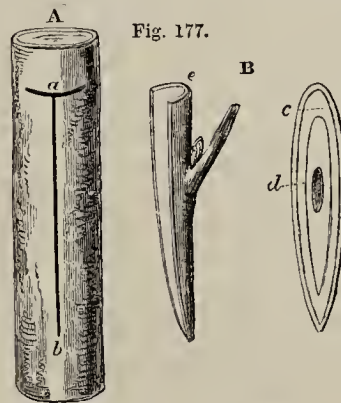


Fig. 177.

Shield-budding.

B B the bud in different positions. In operating, take a shoot from the tree from which buds are to be worked, and immediately cut off the leaves at half the length of the petioles. Make a transverse incision *a* in the

stock A, and from the middle of this make a longitudinal one *a b*. A bud should next be removed from the shoot, by taking the latter in the left hand and entering the knife about $\frac{1}{2}$ inch below the bud, more or less according to the size of the stock and of the shoot; with a clean sloping cut, pass the knife upwards and inwards till under the bud, and then slope outwards so that the eye may be nearly in the middle of the piece or shield thus detached, or rather nearer its upper end. In doing this,

the knife will necessarily cut off a portion of the wood along with the bud, this is usually removed; to do so, turn the cut surface upwards, holding the piece between the forefinger and the thumb of the left hand, enter the point of the knife between the inner bark and upper extremity of the wood at *c*, raise this extremity a little, so that it can be laid hold of between the point of the knife and the edge of the nail of the thumb, and then, with a sort of twitch, remove the wood. When this is done, see that along with the wood, the base, root, or core of the bud, as it is variously termed, is not also removed. If this come along with the wood, leaving a hole at *d*, the bud will not likely succeed, and another bud should be taken off more shallow, so that the portion of wood to be removed may be very thin. The base of the bud at *d* is greenish, and of a pulpy, herbaceous nature; it is, in fact, the commencement of the medullary sheath, the upper extremity of which is terminated by the growing point. If the wood comes clean out, with the exception of a few slight woody fibres connected with the lower part of the base of the bud, these need not be removed; for, in attempting to do so, the tissue on the inner bark is very liable to be bruised.

The bud is now ready for insertion. With the ivory handle of the budding knife, raise the bark of the stock *A* at each side of the incision *a b*, commencing at the corners immediately below the cross cut at *a*. In raising the bark, the handle of the knife should never touch the portion of cambium lying on the alburnum, but, to avoid doing so, should be slipped along, pressing against the inner bark. In short, the handle of the knife must not be used like a wedge forced in between the wood and bark of the stock. Mr. Knight frequently dispensed with the knife-handle in raising the bark he merely lifted it between the blade of the knife and edge of the thumb. When the bark is sufficiently raised to admit the bud, take the latter by the petiole and gently introduce it with the assistance of the ivory handle. Let the part *e* of the shield be at the cross cut *a* of the stock, and, keeping the bud steady with the thumb of the left hand, cut off the top of the shield, so that it may fit closely to the upper edge of the cut at *a*. The bud or shield must not be forced down like a wedge; on the contrary, it should be introduced so as to touch the cambium of the stock as little as possible, till its inner bark, and the

cambium adhering to it, can be directly applied to that of the stock; these coalescing, organization proceeds, and, circumstances proving favourable, a union is soon effected. The operation, to be done well, should be done quickly, for the organizing tissue is very delicate, and soon becomes vitiated by exposure to the air; therefore, the least possible delay should take place between the raising of the bark and the application of the bud. If exposed for some time to the full influence of the air, the cambium would become brown, and form a species of thin dead bark, and, although this may serve to protect fresh tissue that may be forming under it, yet it cannot unite with living tissue placed in contact with it.

The bud, after having been inserted, must be bound in with fine matting or worsted; and, in doing this, care must be taken not to shift the bud in any way that would cause friction, and so injure the tissues below it. In tying, commence below the end of the incision at *b*, and pass the tie closely round as far as the bud. The shield ought here to be pressed close, in order that the base of the bud *d* may be close on the alburnum. This should be done with the fingers, without, however, injuring the bud; and, whilst the shield is thus kept particularly close to the stock at that part, the tie should be brought round tolerably close to the under side of the bud, and the next turn must be wider, so as to clear the point of the bud, and allow it to peep out between the turns of the tie. Continue binding closely, and so that one of the turns may embrace under it the cross incision, the top edges of the raised bark, and the upper edge of the shield, which, as already observed, should be close to the sound bark of the stock at the cross cut *a*. Make one or two turns more, and draw the end of the tie under the last turn to fasten it. The operation is now completed. In some cases it is advisable to shade the part budded for a few days from the direct rays of the sun. In the course of two or three weeks, it will generally be seen whether the buds have taken or not. If the portion of the petiole drop off, it is a sign that the bud has taken; if, on the contrary, it wither or adhere, it is an indication that the bud is either dead or dying. As soon as it is ascertained that the buds have taken, the ties should be loosened, and these, indeed, ought to be frequently examined, in order that they may be slackened and retied, if they are becoming too

tight, in which case they would gall the budded part. This will take place quite independently of the inserted bud, and its success or failure, at least as regards buds that do not push into shoots till the following spring. The circumstance of the ligature becoming sooner or later over-tight, depends, in a great measure, on the greater or less vigour of the stock, and the activity of its vegetation after the bud is inserted. If the stock is vigorous, with healthy foliage, and if the period after the insertion of the bud is favourable to growth, the leaves above the bud will rapidly form woody layers, and thus soon increase the thickness of the stem too much for the ligature, which, under other circumstances, might not have required loosening for a long time. It should therefore be borne in mind that those stocks which have the greatest quantity of healthy foliage, are those which require the earliest inspection for retying. This having been attended to, nothing more is required till the following spring. In the meantime, till the end of autumn, the foliage of the stock will contribute to the increase of the stem and the production of roots, which in the following season will supply the bud with abundant nourishment.

In spring, before vegetation or the flow of sap becomes active, the head of the stock must be cut back to within a few inches of the bud. This stump should also be cut back close to the bud after the latter has pushed a shoot, having sufficient foliage to receive the flow of sap, but previously, the stump will serve as a support to which the shoot from the bud can be secured. In some cases, the head of the stock may even be cut off before winter, but this is not advisable if the bud is so prominent that, if the winter should prove mild, it would be liable to push too much before spring, in consequence of the bud being the only point of attraction left for the movement of the sap. When there is no danger of this occurring, the stock may be headed back immediately after the fall of the leaf, and the consequence will be a stronger shoot from the bud in the following season. At any rate, the stock should be cut back before the sap commences to move actively in spring, otherwise, the vigour of the whole plant will be diminished.

Inverted T-budding.—In this mode (Fig. 178) the transverse cut is made at *b*, and the longitudinal one is commenced at *a*, in preference below a bud, and is continued down to

the transverse cut *b*. The bud, having been inserted, is cut across at *c*, to join exactly the section *b* of the stock, and is afterwards treated as in shield-budding.



Inverted T-budding.

Different opinions are held as to the comparative merits of the two modes of T-budding. In the south of France, the inverted one is preferred for the propagation of the orange tree, and is said to be more successful. Its success appears

to depend on whether the bud derives its supply of nourishment from sap having an ascending or a descending movement. Let Fig. 179 represent T-budding, and Fig. 180 inver-

Fig. 179.

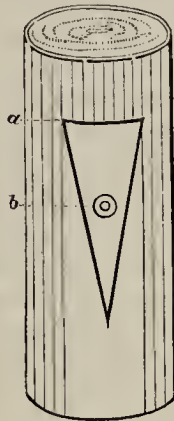
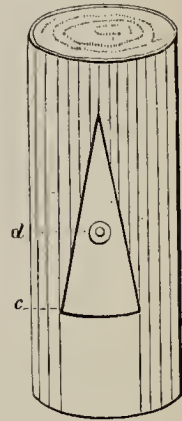


Fig. 180.



ted T-budding. In the former, *a* is the cross cut, and *b* a point where the base of the bud is situated; in the latter, the corresponding parts are marked *c* and *d*. The parallel lines represent, in both figures, the downward course of the returning sap. Now, it will be seen that the direct course of the returning sap is interrupted by the incision *a*; and, until its communication is restored over the space *a b*, the base of the bud *b* is twice as far from the continuous downward channels as the bud *d*. In Fig 180, the two sides of the triangular space, from which the bark has been raised for the insertion of the bud, are exposed throughout their whole length to the course of the returning sap, and the latter can therefore soon flow to the centre of the space. This being the case, inverted T-budding may frequently be found the preferable mode of the two.

Square Shield-budding consists in merely cutting out a square patch from a strong branch

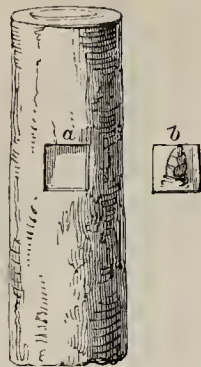
or stem, *a* (Fig. 181), and a similar piece, but furnished with an eye, from another strong branch. Having been exactly fitted, it may be covered with a piece of paper,

pierced with a hole for the eye; or adhesive plaster will answer exceedingly well. This mode is sometimes adopted for spring-budding trees having thick bark. It has the advantage of covering, exactly, with the inner bark of the piece containing the bud, the whole of the alburnum laid bare; but in T-

budding this is impossible, as it is, indeed, with any method in which the shield is introduced below the bark. Instead of cutting out the square piece entire, some make the incision across the top, and down the two sides, but not across the bottom; and the bark is peeled down to this, and replaced by the shield, over which the loosened bark is brought up, a hole being made in it for the bud to push through. As this piece of bark is exactly the size of the place from which it was taken, and of the shield which is made to fit that place, it is evident that it can only cover the latter, and that it cannot extend over the edges of the wound where it is most wanted; therefore it is not so good as a bandage, which protects the edges of the wound from the weather, and keeps the whole close together.

Flute-budding (Fig. 182) is so named from the parts being made to fit like the top of a flute. A cylinder of bark is taken off from an even part of the stock at *A*, and is replaced by another cylinder *B*, furnished with buds and made to fit close to the sound bark of the stock at *e*. It only requires a slight bandage to cover the junction of the barks at *e*, and a cap of soft adhesive plaster to keep out the wet, and to prevent evaporation at top. Walnuts, and other thick-barked trees, are propagated in France by this mode.

Fig. 181.

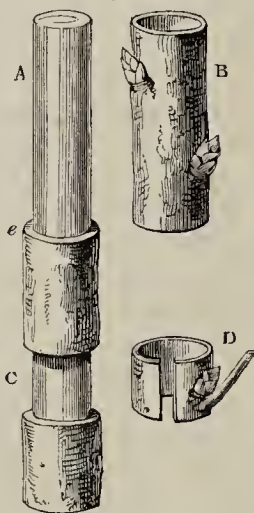


Square Shield-budding.

Ring-budding.—In this, a ring of bark is taken off at any convenient part of a stock, or branch, as at *c* (Fig. 182). From another shoot, or branch, a piece *D*, of the same dimensions as that removed from the stock, is traced by two circular incisions, and a longitudinal cut, made between the two circular ones, permits the piece to be taken off and applied to the stock. The piece *D* should be taken from a part somewhat wider than the stock, for, when found too wide, on application at *c*, the edges can be pared till they just meet when the piece is brought tightly round. A bandage, leaving an opening for the bud, is applied, and the operation is completed. It will be observed, that budding by this mode can be performed without cutting off the head of the stock.

Shield-budding with a portion of Wood, or American Shield-buddings.—This does not differ from the common method, except that the slice of wood is not removed from the shield. The latter should be cut off rather thin, with a very sharp knife, and immediately inserted and bound up in the usual way. This mode answers well for spring-budding fruit-trees, roses, &c., the shoots being taken off, as in the case of grafts, and eyes selected that are disposed to push and make a shoot in the course of the summer. It is also used in summer, when the bark does not easily separate from the wood, and when budding must nevertheless be proceeded with. If buds, inserted at the usual time, and in the ordinary mode, are seen to fail, wooded shields may still be employed with a chance of success. According to Downing, this method, which he terms the American variety of shield-budding, is found much preferable to the common mode for the American climate, in which many trees, and especially plums and cherries, nearly mature their growth and require to be budded in the hottest part of summer. The operation can be performed with less skill than is required to remove the wood from the shield, is performed in much less time, and, observes that much respected author, is uniformly more successful.

Fig. 182.



Flute and Ring Budding.

XII.—PROPAGATION BY INARCHING.

This mode of propagation, which is also called *grafting by approach*, depends on the same principles as grafting; in the latter, however, a part is entirely detached from a plant, and placed so as to grow upon another part; whilst,

in inarching, both parts are nourished by their own roots, and thus co-operate in forming a union. In woods and thickets, branches of trees have frequently been observed to be united, but this only occurs when the barks of contiguous parts are bruised, or fretted, so that the alburnums can come in contact.

Inarching was formerly more employed for uniting two or more trees for picturesque effect, than for the purpose of propagation. In rustic gardens, for instance, doorways were formed by planting two trees of the same kind, one on each side of the intended entrance; these were trained upright to the desired height, and then their tops were bent to form a Gothic arch, and united where brought into contact, so as to form but one head. Trees to form arbours, &c., may be so united, or the stems of several trees may be inarched to a central one, which may ultimately be rendered independent of its own stem and roots. But inarching is now chiefly employed for propagating such exotic plants as cannot be readily propagated by other means.

There are various modifications of inarching, all, nevertheless, depending on the principle of bringing the cambium of the individuals into contact. The simplest mode is represented in Fig. 183, where A is the stock; B, the plant to be inarched upon it. The two may be planted and growing in the ground, one of them may be growing in a pot and the other in the ground, or both may be in pots, but in each case the mode of proceeding is essentially the same. At a convenient place where A and B can be brought in contact, as between *a* and *b*, cut off corresponding slices from each; then bind the parts together, and clay, or otherwise protect, as in grafting. The stock may be allowed to remain at full length, or it may be cut back to *c* or *d*, and afterwards to *a*. When the two have formed a union, B may be separated from its own roots, by cutting it off in the direction of *b*, thus leaving it wholly dependent for support upon the roots of the plant A. Before this final separation is made, it is advisable to wean off gradually the portion *b e* from its original source of nourishment, by making an incision below

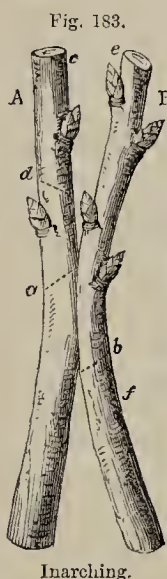


Fig. 183.

Inarching.

b, deepening it from time to time, till, at last, there is but little communication left between B and its proper roots, when that little may be cut off without causing any material difference to the inarched part *b e*. Instead of diminishing the connection between the inarched part and its own roots, by gradually cutting in at, or below *b*, it is a good plan to take off a ring of bark, as at *f*, when the nature of the plant will permit. This may be done by degrees as the union is effected. The sap will flow upwards, through the vessels of the alburnum, to nourish the parts above *b*, but the returning sap will be checked when it comes to the ringed part, and must then direct itself with greater force towards the junction, and will consequently flow down in greater quantity by the liber of the stock A. Now, it cannot do so without forming a proportionally greater quantity of alburnum as it descends; and, by the vessels of the alburnum so formed, sap will be conveyed upwards to the source of their origin, in B. If buds are retained on A, with the view of maintaining the necessary amount of circulation in the stock till that can be done by B, care should be taken to check the shoots that push from them; for, if allowed to grow vigorously, they would attract the sap from the part B. On referring to the figure, it will be observed that on the separation being effected at *b*, there must be a heel left at that place which will take some considerable time to heal over.

Inarching is sometimes done with a tongue, but, in any case, it does not form so nice a junction as whip-grafting, where, in conse-

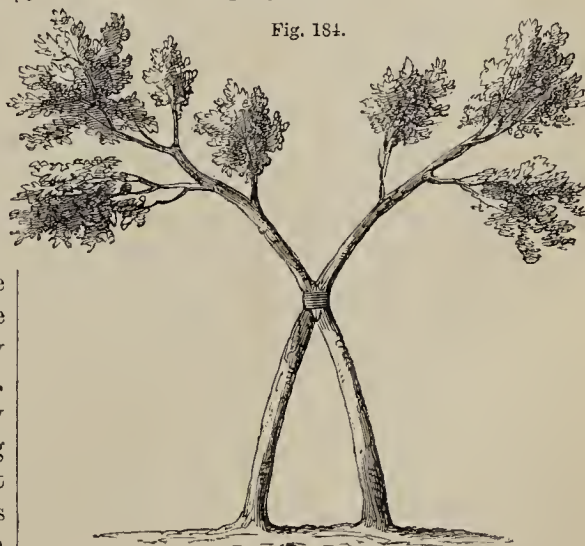


Fig. 184.

Sylvan Inarching.

quence of the lower end of the scion being made thin, there is scarcely any inequality.

The stems of young trees are frequently inarched, so as to form a lozenge-shaped trellis-work, or an arch, as in Fig. 184. Summer shoots may also be inarched on shoots of the same age, or on a stem or branch several years older than themselves. In this way, branches which have died, or become diseased, may be readily replaced by others, so as to preserve the regular appearance of the tree.

CHAPTER XIII.

TRANSPLANTING.

Transplanting is the removal of a plant from the place where it has previously been growing, and placing its roots again in the soil, in a new situation. The utility of this operation is obvious. Were it not for transplanting, the seeds of plants would have to be sown where they are intended to remain. Plantations of fruit and forest trees can be reared much sooner by means of transplanting, at less expense, and with a greater certainty of success, than they otherwise could. Plants for hundreds of acres can be sown in a nursery, and reared in a comparatively small space for several years, till fit for transplanting; and in this way they can be much better taken care of than would be the case if, instead of transplanting, seeds had to be sown where trees are intended to be produced, at perhaps 30 or 40 feet apart, and where the seedlings would be exposed to all manner of accidents in their very young state.

The spongioles, by which nourishment is taken up from the soil, are extremely delicate, yet they gradually elongate and push their way among the particles of soil, if this be of a nature at all permeable. In a sound state each contributes to the general supply required for carrying on the vegetation of the tree, and, under favourable circumstances, the supply they afford is adequate to the demand. Much of this supply consists of water, and the carbonic acid which it holds in solution; and if all the roots of a plant could be taken up without the least mutilation, but deprived of every particle of soil, and kept quite as moist as they were in the ground, they would continue to afford support to the plant for a considerable time. Some plants spread their roots in water only, and, in this case, the roots suffer no injury

either in their removal from the water or on their being replaced in that fluid. They are taken uninjured from their source of nourishment, and introduced, in the same perfect state, to where they continue their functions as before; consequently, the plant experiences no derangement of its organization, and no check in its growth. To secure these conditions should be the principal aim in transplanting.

In removing the roots of plants from soil, and transferring them into soil again, the spongioles, tender, as in all plants they invariably are, must be greatly injured, and in many cases, the greater part of them must be totally destroyed in the taking up. Again, in replanting, when covered with a mass of soil, such of them as were previously entire cannot be in a similar position to that in which they formerly were, and where they could gently wend their way in the interstices of the hardest materials without pressing more against any obstacle than their tender tissues could bear. In their new situation, however, they are liable to be squeezed between stones and hard lumps of earth; and that, too, when they are, perhaps, in a reversed position. Injury, to a greater or less extent, is unavoidable; it may be slight in some cases and extensive in others, notwithstanding that the greatest amount of skill and care has been employed in conducting the mechanical operations. Such being the case, it becomes necessary to inquire, under what circumstances the plant can sustain those injuries without suffering materially as regards its future success. The age of the plant, its state of vegetation, the state of the weather, and that of the soil, are the first considerations.

The age at which plants may be successfully transplanted varies, of course, according to the species. Most plants can be transplanted when very young, and from that time till they are middle-aged, if due precautions are taken, and adequate mechanical means employed. Indeed, with such means and proper care, plants of any age can be transplanted, although, when the subjects are naturally approaching decay, they are not worth the trouble. Many tender plants, raised under glass, are transplanted from the seed-pans as soon as they can be laid hold of; or, in other words, they are *pricked out*, as the operation is termed in the case of very young plants, into pots, or elsewhere, at such distances as will permit them to advance in

growth, without being crowded, and drawn up weakly in consequence of their foliage not being fully exposed to the light. There are, besides, other advantages from this early removal. In a young state, the quantity of roots is usually large in proportion to the tops, and, therefore, if a portion of them is broken, there are still sufficient to feed the plant, and, with due precaution as regards shading and watering, the effects of transplanting are but little felt; on the contrary, the slight check to the spongioles of the rootlets tends to encourage the emission of a greater number of lateral ones, and thus the plant is better fitted for subsequent transplantations than if such early removal had not taken place.

There are many plants that require to be nursed till they have sufficient strength to bear planting out in the open quarters. In general, if there be any great interval between the period of their vegetating from seed, and that of their final planting out, an intermediate transplantation is beneficial.

The state of the vegetation of the plant is another important consideration; for some things are best transplanted when they are in an active state of growth; others when they are comparatively dormant. Annuals do best when transplanted before they commence to form a flower-stem; herbaceous perennials, just before the growth of the season commences; deciduous trees and shrubs, as soon as the greater portion of their leaves have fallen in autumn, and whilst vegetation still possesses some activity to push fresh roots before winter, the production of these being also encouraged by the temperature of the soil being higher than that of the air at that period. Next to this last stage of vegetation for the season, is that immediately preceding the commencement of active growth in spring; for, although the leafless plant would not suffer from evaporation at any time during winter, yet, as the wounded roots cannot heal, owing to the inactivity of vegetation, they are apt to die back to a greater or less extent, especially in wet, cold soils.

The transplanting of some kind of plant or other has to be performed in every month of the year, weather and state of the ground permitting. Dry weather is of course unfavourable; the operation is, in most cases, impracticable during severe frost, or when the ground is covered with snow; and in very wet weather the soil is apt to become puddled in work-

ing, and does not then fill in well amongst the roots, except in such cases as it may be made of a thin consistence. Mild weather, with a moist atmosphere, is the best for transplanting. The air may be excessively dry, even in the shade, and a plant transplanted under these circumstances will, consequently, be liable to suffer, although not exposed to the sun's rays; but, when so exposed, the drying effects are greatly increased, as may be observed when cut herbs are placed, some in the sun, and some in the shade, for an equal period. Whilst the former still retain moisture enough to be pliable, the latter will be quite dried up and fit to grind to powder. Hence may be inferred the benefit of shading plants from the sun, when newly transplanted, or until they have struck fresh root. This is more necessary when the plants have foliage than when they are without it; because, in the former case, the surface from which evaporation takes place is so much greater. If a shoot be $\frac{3}{4}$ inch in circumference, and 20 inches in length, the exposed surface is equal to 15 square inches; but if the same shoot is furnished with twenty leaves, averaging, say about 2 square inches each, or presenting, collectively, an area of 40 square inches of upper, and 40 of under surface, the surface from which evaporation takes place would be increased to 95 square inches, or to more than six times what it would be if no leaves existed.

For deciduous trees, as already stated, the best time is before the ground becomes too cold for the broken roots to heal over partially, or to form callosities from which spongioles can readily push in spring. In some kinds of trees and shrubs, fresh roots are formed even before winter, but these often prove too tender to endure the severities of that season. It is therefore better, in cold, wet soils, if fresh roots do not push till spring, when their growth can proceed with the season, without check. In warm, well-drained soils, trees may be advantageously planted so early in autumn as to insure the tree being well established with fresh roots before winter. When this is aimed at, it will be advisable not to wait till nearly all the leaves have naturally dropped. In the absence of frost, shoots produced late in autumn, retain their foliage late. The greater part of such shoots, where not wanted for leaders, should be cut off, and, likewise, nearly all the older foliage. Transplanting deciduous trees may then be

done in the last week of September, or first fortnight of October. It may be remarked that the apricot, peach, nectarine, currant, gooseberry, and such kinds of trees as push early in the spring, are best planted in autumn. When these have pushed into leaf, the apple shows little sign of active vegetation; it is, therefore, not so apt to suffer from spring planting.

Mr. M'Nab, an excellent authority, considers the period between the middle of October and the middle of December as the best for transplanting evergreens; but he states that they may be removed from the middle of October till the middle of February. Mr. Glendinning says that August is a good month to begin transplanting, but that September is the safest month. We should recommend the last fortnight of September, and the first fortnight of October; the temperature of the soil is then from 53° to 58°, near London, or as warm as it is from the third week of May till the middle of June; therefore, certainly warm enough to encourage evergreens to make fresh roots. They will not so rapidly do so then, as they would with a corresponding ground temperature in the beginning of summer, when the days are longer, and vegetation more active from the greater amount of light; nor is it necessary that they should do so, because the dryness of the air is fully one-third less in the end of September and beginning of October, than it is when the ground is equally warm, in the end of May and beginning of June, and, consequently, the demand on the roots to supply the loss by evaporation is so much the less. We therefore conclude that the former period is generally most proper for the transplantation of evergreens. With proper care, however, they may be safely transplanted during the period stated by Mr. M'Nab, provided the weather is favourable. It will, doubtless, frequently be the case, that the transplanting of evergreens cannot be entered upon so early as September, owing to a pressure of other garden work, and the attention necessary to be paid at that period to crops and pleasure grounds. Sometimes the weather is mild up to the end of November; and if there be little frost, and no fall of snow to melt and render the soil cold, evergreens transplanted as late as the middle of that month, will make some roots to support a little circulation, and supply the very limited amount of evaporation which can take place

at that season, the air being almost constantly saturated with moisture. It is scarcely necessary to observe, that evergreens, as well as deciduous plants, may be transplanted at any season, if they are taken up with a good ball, just as plants in pots may be shifted at any time.

The soil, in general, should be prepared by draining, trenching, and other means recommended for the improvement of soils. Plants strike root more readily in well-trenched ground than they do in that which is not trenched. One would suppose that, if the soil is of sufficient depth for the roots to be in dug or loosened soil, it can be of no consequence, so far as regards their first starting, whether the ground below the roots of the transplanted trees be loosened or not; but we have observed it to be invariably the case, that when trees were transplanted in well-trenched ground, they succeeded better in the first instance than those that were planted without any such preparation, other circumstances being the same. This can scarcely be accounted for, but such is the fact; we can, therefore, recommend trenching as a highly necessary operation, preparatory to transplanting. Nor is it merely in the first instance that its beneficial effects are evident, for the tree thrives much better afterwards than if the roots had been put in a hole where the soil is loosened.

When transplanting has to be performed in continued dry weather, it is a good plan to dig the ground two spades deep, and, as the top one is turned down, it should be thoroughly watered. This proceeding will render less watering necessary after the ground has been planted.

The operation of planting varies according to the nature of the plant, and the natural disposition of its roots; for, in some, these are spindle-shaped, in others they creep along just below the surface; and, in planting, the roots should generally be placed in conformity with that disposition. We say generally, because there are cases in which it is desirable that the roots should be encouraged to spread horizontally, instead of following their natural tendency downwards. The details of particular modes can be best given in treating of the cultivation of each plant; we shall, therefore, confine our observations to that which is applicable to the planting of the generality of young fruit and forest trees.

The ground having been prepared by draining, trenching, and manuring, according as the nature of the plant and soil may render necessary, the first operation is to dig holes for the reception of the roots of the plants to be transplanted. The size of the holes depends on the size of the plants; but it is better to make them large than too small. The depth should permit the neck of the plant to be as near the surface as it was before, provided the soil is in good condition, and other circumstances are favourable. If the subsoil is bad, or wet, there is sufficient reason for planting shallow, or even on raised mounds; but it is desirable that such subsoils should be corrected, otherwise the plants, if deep-rooting, cannot thrive. We shall, therefore, presume that the ground is, as it ought to be, in good condition. The diameter of the holes must be sufficient to allow of the roots being extended at full length. There is a difference of opinion as to whether the holes should be made square or round. We much prefer the square form. In the first place, a larger hole can be sooner made; but there is another point of still greater importance. Although the ground may have been well dug, yet, when the spongioles come to the side of the hole, they have to penetrate a firmer medium than that of the more recently loosened soil within the limits of the hole, whether this be round or square. In the former case, however, the resistance is more direct. No roots proceeding from the centre of a circle, or from the base of a root situated there, can radiate towards the side of a circular hole without having to turn at less than a right angle; whereas, in a square hole, the sides can only be directly approached from the centre at four points, and at these, the roots can turn aside at not less than a right angle. At all other parts the roots meet the sides obliquely, excepting when directed towards the corners, and then they have the advantage of a long run to acquire strength before they encounter any obstruction. In digging the hole, the best soil should be laid on one side, the rest on the opposite one, leaving the other two clear for a line to be stretched. The hole ought to be made quite as wide at bottom as at top, if the nature of the soil admit of the sides being perpendicular. It should also be deeper at the sides than at the centre; in other words, the bottom ought to be convex, not concave like a basin. In dry weather the bottom may

be dug, but still formed convex, as above recommended, and watered; but the water should be allowed to subside, so that the soil may be moist, but not saturated, or in a working condition at the time of planting. The hole being ready, the plant should be examined. If the top is irregular, it is advisable to reduce it to some form before planting. Cross branches, or others that are very badly placed, should be removed; but, except in the most obvious cases, the removal of branches, and other pruning, should be deferred till after the tree is planted. Attention must next be directed to the roots; all that are bruised should be cut clean with a sharp knife. If, in consequence of long carriage, or other unavoidable causes, the small fibrous extremities are found in bad condition, or dead, they should be cut back to parts that are sound. Some plants will bear the cutting back of the roots better than others; some emit fibres in great abundance from where a root has been cut back; and, with regard to these, it will sometimes be advantageous to shorten the roots, or at least some of them, in order to have fresh fibres near the stem. When roots are matted with fibres, these should be disentangled as much as possible, or even thinned with the knife. Tufts of fibrous roots should not be buried together. If such cannot possibly be divided and spread out so as to be tolerably well separated by soil, introduced amongst them in planting, the knife may be judiciously applied. The plant being prepared, its roots should be placed on the convex surface, to ascertain whether the hole is of the proper depth. This can be judged pretty well by the eye; but it is more sure to lay a straight rod, close to the stem, across the hole, resting it on the level ground on each side. It may then be seen whether the neck of the plant is too high or too low, and the hole should be deepened, or made more shallow as the case may require. But whatever alteration may be necessary in this respect, the hole ought to be brought to the proper form, as above directed, before the tree is planted, that is to say, it should, if possible, be as wide at bottom as at top, and the bottom convex. This repetition will be excused if it tend to draw attention to that on which the better success, not of a single tree only, but of many thousands may depend.

It having been ascertained that the hole is in every respect properly formed, the planting may be proceeded with. Let the stem be held

in the position it ought to occupy, erect, if for a standard in a sheltered situation; but in one that is exposed, incline the tree a little towards the side from which the strongest gales may be expected, or from which trees in the vicinity are observed to lean. At the same time, let the tree be held lightly till the roots, or at least the lower portion of them, can be spread nicely over the convexity, or mound of soil, raised in the bottom of the hole. Train out the leading roots as much as possible at equal distances; then the smaller roots and fibres. To the latter particular attention should be paid; they ought not to be bundled together, and then covered with soil, like faggots in a drain; they were not so disposed when the tree was taken up. It may have been observed, in carefully taking up the tree, that the lateral fibres had taken a diverging route, and that from the point of branching off, they were, for the most part, completely separated from each other by particles of soil. In planting, this should be aimed at as much as possible, keeping them, at the same time, in a natural position; for, although the fibres diverge in different directions, yet it should be recollected that their general tendency is forward, and away from the stem of the tree. Very inconsistent with this natural tendency, is the common practice of scattering the earth with the spade against the direction of the roots; for, by so doing, all the fibres that have not been earthed over by hand are liable to be turned back towards the stem, by particles of soil, thrown with force in that direction, and kept in a reversed position by the weight of earth. Instead of this, the soil should be thrown from near the stem towards the extremities of the roots. When the roots are partly covered, the tree may be moved or shaken a little, but very little; it should not be moved up and down, because by so doing the fibres will be drawn up, and when it is let down again they will be more or less doubled. If a piece of whip cord, which may be taken to represent a tough flexible root-fibre, be fixed to the end of a stick, laid out straight, and covered with soil, it will be seen that, when the stick is drawn up, the cord will also be drawn up so much through the soil, and that when the stick is pushed down, so as to occupy its former position, the piece of cord will not do so, but will form a double; and so it is with the fibres of the roots. It is, therefore, not advisable to shake or otherwise move the tree much

in planting, in order that the soil may fall into cavities among the roots. It is better to introduce it carefully by hand. Some use a taper blunt-pointed stick for the purpose; and though this may be advantageous in some cases, yet the hands are more to be trusted. When the soil is of a friable nature, it may be washed in among the roots; and in some cases the soil in the bottom may be made into a puddle, and the roots immersed in it, care being taken that they are properly spread out.

When the lower portion of the roots is covered, those above should be put in a proper position, and soil introduced amongst them with due care; and, when all are well covered, water may be given as found necessary. If the soil and weather are moist at the time, watering may be dispensed with; but otherwise, care should be taken that all the soil about the roots is thoroughly moistened. In dry weather part of the soil may be reserved till a copious watering has been given; when the water has subsided the soil may be levelled round the stem, and the looser it is, and, we may add, the drier it is, the better will it resist drought.

We have not alluded to treading the soil on the roots whilst the tree is being planted. This is less practised now than formerly, when it was done too indiscriminately. In general it is not necessary, though in some cases it may be done, but only in a moderate degree. Some plants grow best in loose soil, treading in this case is not necessary; others prefer firm soil, and in planting these, it may be made rather compact than otherwise. Where the soil is wet at the time of planting, treading should be avoided; if dry and light, it may be moderately pressed.

If planting is conducted according to the above directions, success will almost invariably be the result. In particular cases, some after care is necessary in respect to watering, mulching, and staking. The trees will soon give indications of want of water; but, in guarding against dryness, too much moisture should be avoided. With the exception of water-plants, most others will make better and more substantial roots in soil that is moist, but not saturated. When it is watered it should be so thoroughly, and, for the time, it will, of course, be saturated with moisture; but it should not be maintained constantly in that condition. In well-prepared ground the superabundant water will soon subside, after which

the soil will retain sufficient moisture for a longer or shorter period, according to circumstances connected with the state of the weather, nature of the soil, and extent of evaporating surface which the foliage of the plants may present; and whilst, on the one hand, continued saturation of the soil is to be avoided, any deficiency of moisture approaching to dryness must be carefully guarded against on the other; for it should be recollected that newly planted trees cannot bear vicissitudes with such impunity as those which are well established.

Mulching is a good means of retaining a steady degree of moisture about the roots of trees, whether recently transplanted or not, but, for the reasons just given, the former need it most. Besides, if the mulching consists of long dung, or other material containing nourishment in a soluble state, it likewise proves beneficial by the substances which are washed down by rain, or artificial watering. Staking is necessary when the plant is weakly, top-heavy, or planted where it would be liable to be shaken too much by wind before it can re-fix itself in the soil by fresh roots. If trees have been well reared, and transplanted at the right age, and in a proper manner, they will rarely stand in need of stakes; nevertheless, when trees, not the best that could be reared, but the best that can be had, have to be planted, and when trees of considerable size are required to be transplanted for immediate effect, or for coming sooner into a fruiting state, the support of a stake or stakes becomes, in any case, absolutely necessary. A single stake will be sufficient when the tree is not large. The stakes should be secured, first, near the ground, and again, near the top. The greatest security is, however, obtained by three stakes placed so as to form an equilateral triangle at the base, and brought towards each other at the top, where they should be united by cross pieces, inclosing the tree. Three posts or stakes are, of course, less expensive than four, and they are, at the same time, more secure. In supporting trees, whatever mode be adopted, great care must be taken to prevent the bark from being injured by rubbing against the support. When a single stake is employed for a young standard tree, some place it at a little distance from the stem, and then twist a thick hay or straw band once or twice round the tree. The ends of the band are next plaited two or three times round each other

towards the stake, round which they are finally twisted, and tied with rope yarn or tarred twine, with which, also, the plaited band is likewise bound close behind the stem. If there is only a single padding of hay or straw between the stake and tree, it generally gives way, and leaves the two to act upon each other. The tree ought, therefore, to be surrounded with twisted hay or straw bands, and a pad of the same kind of material should be secured against the part of the stake which is to be brought in contact with the bands surrounding the tree. Before the stake and tree are bound together, it will be necessary to adopt some means to prevent the cord, employed for that purpose, from cutting through the bands, which, after a time, it would most probably do. A piece of leather, or stout canvas, may be used, or some bits of old lath, placed on the opposite side of the stem, will answer the same purpose. The tree and stake may then be firmly tied together. In the case of a large tree, a triangular support, formed as above, should be made use of, and the stem having been securely padded, may be bound to the side from which the strongest winds prevail; or three short bars may be placed close against the padding of the tree, and nailed on the three bars which connect the tops of the poles, so as to keep the stem from shifting backwards and forwards. In some cases, guy-ropes may be found necessary for securing trees with large branching tops, and without a tall central stem to which a triangular support of poles could be well applied.

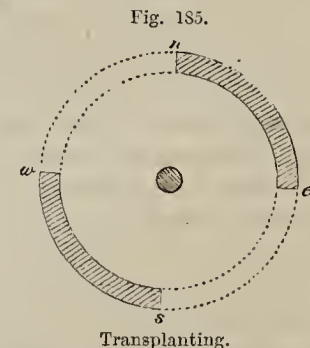
Transplanting Trees and Shrubs of a larger size than that at which they are usually removed.—The preparation of the plants for transplanting chiefly concerns the roots, but trees and shrubs should have their tops regulated a season before removal, in order that the wounds may be healed whilst the roots are entire, and the vigour of the plants unimpaired. The healing is, of course, better effected when this is the case, than when vegetation is checked by transplanting. Plants that have been growing in thickets and in sheltered places are apt to suffer, to some extent, when removed to open situations. Even deciduous trees, when they have been shaded, and most of their foliage has been produced under a limited amount of light, suffer on removal into a more open space where they are fully exposed to the direct rays of light, to which, perhaps, they have never previously been sub-

jected. A sudden change to full light is as much as foliage grown in the shade can bear, even if the roots are not disturbed; but when plants have to suffer from that change, as well as from the effects of removal, at the same time, they often give way under the double trial. It would therefore be advisable to expose the foliage as much as possible for some time before transplanting. If growing in thickets, other plants can either be removed, or they may be drawn aside from those intended to be removed. This is better than to transplant them unprepared, and then trust to shading, which must otherwise be adopted as the only alternative.

It is generally the case that, when a branch is shortened back, several young shoots break out below the section. If the top of a tree consist chiefly of long naked branches, and if these be shortened back considerably, a crowd of shoots usually break out from the previously naked part of the branches left. The tree is thus furnished with shoots and foliage near the stem. In a like manner, if roots that are nearly destitute of fibres for a considerable distance from the stem are shortened, the comparatively naked portions left will push out a quantity of fresh fibres, either at the section or nearer the stem. These young roots will rapidly increase, especially if encouraged by fresh soil; and the tree will soon acquire as many feeders as it had before, but with this difference, that, previous to the amputation, the main portion of the feeders were far from the stem, but in consequence of the operation they are produced comparatively close to it. It is, of course, much easier to remove a tree with a sufficient quantity of fibrous roots within a short distance from the stem, than it is when the same quantity is, for the most part, far distant from it; and hence the advantage of causing the roots of a tree to push near the stem previous to its being transplanted. This can be done by digging a trench all round at a moderate distance from the stem, and cutting off all the roots that extend across the trench. When this is cleared, the cut ends of the roots left should be examined, and any that are bruised must be cut clean with a sharp instrument. The trench should then be filled with good soil, of as light a nature as possible, in order that the ends of the roots may not be injured by exposure to the air. During the growing season, roots will generally form very abundantly, so that in autumn a trench may

be dug outside the limits of the former one, the soil of which, being light, can be easily separated from the young roots; and, if they are preserved, the preservation of a ball is not of so much importance as would otherwise be the case. Instead of filling in the soil, some have successfully tried the plan of boarding over the trench, and placing earth over the boards, in order to exclude the air, and to preserve moisture in the cavity beneath. By this mode, young roots, from want of soil to travel in, are not encouraged to extend beyond the limits of the ball, but more of them will be formed in it, and, consequently, success in transplanting will be rendered more certain. It may, however, be remarked that the quantity of roots which by this mode can only break out laterally from the old roots into the firm soil, will not be so great as if they had been encouraged to strike into a trench filled with good, fresh, loose soil. As the production of roots in the former case, must be comparatively limited, so must also be the nourishment supplied, and the reduction of the vigour of the tree must consequently be greater. In fact, there is danger of the vegetation of the tree being so reduced that, when transplanted, the power of producing fresh roots will be too much diminished; therefore, we conclude that, instead of adopting this mode, it is better to encourage an abundance of roots by filling the trench with soil. The distance of the trench from the stem depends on various circumstances—such as the size of the tree, the mechanical means at command for its removal, and, it may be, the extent of clear space through which it may have to pass to its new situation. The less, of course, that is cut off from the extremities of the roots the better. If, however, it is found necessary to cut far back, it will, in that case, be advisable to cut partly, say one half, round in one year, and not wholly

round till the next. By so doing, the vegetation of the tree will receive a less check than if all the roots had been shortened at once. In cutting out a part of the trench, equal to half way round, it is not meant that



this should be done continuously, so as to form a semicircle, as from *w* to *e* (Fig. 185); but

it should be done by alternate quadrants, as from *n* to *e*, omitting the next space from *e* to *s*, then clearing out from *s* to *w* leaving the portion from *w* to *n*. In the course of the season, fresh roots will push into the portions *n e* and *s w*, and these will support the tree when it is deprived of the roots extending beyond *n e* and *s w*.

We consider the following to be an advantageous plan to be adopted in preparing large trees for removal. Let a trench, a yard wide, be marked out at what may be considered a proper distance from the stem; uncover the roots which traverse the trench, then ring all of them that are of any considerable thickness; and, when this is done, fill in the soil, or substitute better, for young roots to strike in. The extremities of the roots will collect nourishment, which will pass upwards through the alburnum, and will support, almost unimpaired, the vegetation of the tree; but the returning sap cannot pass the rings, and will therefore form at these parts, in the course of one or two years, a sufficient number of roots to support the tree; and this being the case, it is merely necessary to preserve them in transplanting, the other roots beyond the rings being dispensed with.

Preparation for transplanting is occasionally effected by digging round the tree so as to leave a ball, which is exposed to frost till the whole becomes a compact frozen mass, so that it can be moved without danger of breaking. It is evident that this mode can only be adopted in frosty weather, and that it is only applicable to very hardy species, such as will bear the freezing of their roots without injury.

There is a mode, described in Downing's *Horticulturist*, vol. i. p. 171, which deserves notice. It was practised by S. G. Perkins, Esq., of Brookline, near Boston, and its principle, being simple, may be acted upon with advantage in many cases. A bank was left in a plantation, into which a particular pear tree was omitted to be transplanted in spring. Mr. Perkins was anxious to transplant the tree into its allotted space, in the end of May, although it was then in full leaf. He accordingly directed a trench to be cut round the tree, as deep as the roots went into the ground, and about 3 or 4 inches wide. "This being done," says Mr. Perkins, "I had the trench filled with water, and covered over to prevent the earth from getting into it. In this state the tree was left between thirty and forty hours, when

the ball of earth round its roots was found to be very firm and solid, so that the tree could be removed with perfect security; and it was actually done with perfect success, so much so that the tree never stopped growing, and made considerable wood during the summer. I soon after, about June 1, removed several other pear, peach, and apricot trees with the most complete success.

"Encouraged by this success, I removed, on the 18th of June, 1844, ten trees to a trellis that I had recently made—viz., four plums, four peaches, and two apricots, all of which grew rapidly that year, and so filled the trellis that I was obliged to take the peaches away this summer, 1845, in the early part of August, and place them on another trellis which I had built.

"I continued, during the summer of 1844, to remove trees in full leaf, and some with the fruit on them, until the middle of September; and out of seventy-six trees removed, I lost only six, seventy having succeeded perfectly. One tree that was removed, contrary to my advice, after having been prepared only twenty-four hours, lost the earth in part from its roots, and after lingering some time died. The reason of this was, that time was not given for the superabundant water to be discharged from the ball, and it of course was not as firmly consolidated as it would have been, had it been left six or eight hours longer before it was taken up. My gardener now became a convert to my system, and had what he calls a 'turban' made to tie round the ball before it is removed. This has been very useful; for with the aid of this cloth, we can remove balls so large, that they require three strong men to lift them. This year, 1845, I have removed, during the summer, many fine trees, with the fruit on them, with perfect success; some of them were peaches, trained trees, 5 and 6 feet high, and spreading 6 and 8 feet on the trellis."

It is to be observed, that although this mode was employed, as above stated, in the removal of trees in summer, yet it is also applicable in transplanting at any other period when the soil at the roots of the trees is dry. In adopting it, the canal formed round the tree should be steadily filled with water, in order that the soil may not be washed out from amongst the roots; as much as a tubful should not be suddenly turned in to dash along like a small torrent. It should be

quietly and repeatedly poured in, till the mass of soil inclosed by it is completely soaked. This can be ascertained by pushing down an iron rod near the stem of the tree, and on withdrawing it, water will collect in the hole if saturation has reached so far.

We now come to the removal of the tree. In doing this, the constant aim should be to preserve both roots and branches from injury, from whatever cause, so that they may be continued in an efficient state. Bushy or spreading tops should be tied up, to render them as compact as possible. If tall, the central stem ought to be firmly secured to a pole, and the ties should be made very tight, pads of straw, or other material, being introduced between the rope and the tree, and likewise between the latter and the pole. In the case of the removal of a large tree, the next operation is to lay bare the surface roots; by doing so, 1 foot deep of soil may often be disposed of. When a tree is to be taken up with a ball, the removal of so much surface soil is of great importance; for, if the mass to be removed is in the form of a square of 10 feet on the side, the tree being in the centre, and if, within this square, an average depth of 1 foot can be taken off from the surface, the quantity would be 100 cubic feet, less some allowance for the part occupied by the stem, and the weight to be raised would be reduced by about 5 tons. This weight alone would require a considerable amount of mechanical power to raise it; but, besides that, the roots are relieved of a weight which, if not removed previous to their being undermined, is apt to break them down. Having got clear of the superincumbent mass of soil, a trench ought to be formed round the tree, and as far distant from it as the roots are intended to be saved. This trench should be ample, not merely just as wide as a man can stand in, for nothing is gained by working in a confined space, but it should be 3 feet wide; its depth must depend on whether the roots are deep or shallow; and the bottom should be about 6 inches below the generality of the roots. The workman will then possess advantages that will compensate for the extra labour in removing so much soil as is contained in a trench of the above dimensions; he will work with much greater ease, for he will not have to work below the level on which he stands, and this he should always avoid, as much as possible, during the after

process of undermining. By clearing the bottom of the trench as the loosened soil is drawn out, the roots can be better taken care of than when the soil is allowed to accumulate and mix with the portions of roots previously disentangled.

The tree may be taken up by carefully loosening or separating the greater portion of the roots from the soil; or it may be removed along with a ball. We shall suppose that the former mode is to be adopted. If the tree were to be undermined in the easiest and most expeditious manner, the workman would pick out a groove beneath the mass, and level with the bottom of the trench, so as to permit a quantity of the soil, thus undermined, to be easily tumbled down; and this having been cleared away, he will again proceed as before, till the whole is undermined. In this way, however, large lumps of soil will be suddenly precipitated, together with all the ramifications of fibrous roots which they contain. Instead of this mode of proceeding, the soil must be worked out from amongst the roots by gentler means; for instance, when the extremity of a root presents itself, it should be traced back by carefully removing the soil till a lateral is discovered, the latter should then be followed out to its extremity; the main root may then be traced back to the next lateral, which should be treated in a similar manner, and so on. A small round-pronged fork, with a short handle, adapted for being worked with one hand, whilst with the other the loosened fibres are kept out of the way till they can be tied up in small bundles with matting, is useful for this purpose. When an inroad has been effected in the above manner at one place, and the soil which has been worked down is cleared away, the exposed fibres should be protected from sun and drought by placing a wet mat closely over them. When the greater portion of the roots are disentangled, the bundles of fibres should be tied to the stronger roots; and if there be danger of their being affected to any injurious extent by drought, they ought to be covered with mats, damp straw, or moss. To preserve them from breaking in the course of removal, it will, in some cases, be necessary to lay across the surface some poles, planks, or battens, to which the principal roots can be secured by ropes. The tree is then ready for removal, and must be planted according to the principles already explained. For moving trees with

balls of soil, various modes have been advocated. The difficulty is not so much as regards mechanical means, as in the preservation of the roots during the application of these means. The mass of earth and roots cannot easily be rendered sufficiently compact; it may be inclosed, as it were, in a box, but the latter must consist of very strong materials, otherwise it would be crushed by the heavy pressure, or torn to pieces by the strain to which some of its parts would be subjected; besides such materials are not easily withdrawn from under the tree after it is placed in its new situation.

For the removal of moderate-sized and even large shrubs with balls, Mr. Pratt of Cheshunt states, in the *Gardener's Magazine*, vol. xi. p. 134, that he uses plates of sheet iron of various sizes—namely, 4 feet by 2 feet 6 inches, 3 feet by 1 foot 9 inches, and 2 feet 2 inches by 1 foot 3 inches, all of them rounded at the corners, and somewhat like a tray. They are strengthened by flat iron bars, carried round on the under side near the edges, and welded so as to form turned-up handles at each end. When the plant has been undermined on three sides, the iron plate or tray is slipped in below the ball, the remaining side is cut down, and the plant then falls upon the iron, and, having been adjusted in the centre, is hauled up. "If the plant is large and heavy, an inclined plane is dug on the most convenient side of the hole, and a rope being put into the iron handles, the plant is hauled out. A short strong board is, in some states of the ground, used for this purpose instead of the inclined plane. The plant may then, if not too heavy, be carried on a hand-barrow, which admits of the application of the strength of six men—two between the handles, and the other four on the outside. Heavier plants, which are to be carried to any distance, are lifted on a truck with low wheels, made strong for the purpose; and if too heavy for this mode, as many boards as are wanted are laid down in succession, and the plant is hauled by the iron upon these boards to the place where it is to be planted. The plant is invariably hauled into the new hole on the iron, which is not removed till its proper position is ascertained; this prevents the disturbance of the ball of earth or roots. The plant is then lifted a little on one side and the iron drawn out; earth is then filled into the level of the fibres, which are untied and laid out straight, and the plant is earthed up. The

heaviest plants, Portugal and other laurels, 8 feet and 9 feet high, and 6 or 7 feet in diameter, which cannot be lifted by any strength that can be applied without injury to the roots, are thus moved with great ease and expedition, with large balls of earth, and without any disturbance of the roots; and consequently the plants invariably proceed in their growth, often without experiencing the slightest check." There is a great advantage in using the sheet-iron plate, compared with wooden platforms. The latter may, indeed, be introduced below the ball, and conveyed, without much difficulty, to the new situation of the plant; but when set down, the thickness of the wood renders it more difficult to draw out. The friction is not only greater, but whilst the wooden platform is being withdrawn, a portion of the ball must rest unsupported, thus permitting the soil to drop from the under side of the ball; but this is not the case with the iron tray, for, being so thin, it can be slipped out without leaving a vacant space of any consequence behind it.

The plan adopted by Mr. M'Nab, of the Botanic Garden, Edinburgh, does not so completely secure the soil from falling from the bottom of the ball; nevertheless, it is very good, as may be supposed, otherwise it would not have been employed by that celebrated horticulturist. A piece of cord is put loosely round the ball, and between the latter and the cord thin pieces of board, 2 or 3 inches broad, are placed upright all round, at 3 or 4 inches apart. They are then hooped, as it were, to the ball by strong ropes made tight by a rack-pin. By gently drawing the tree, first to one side and then to the other, two strong boards are introduced, and beneath their ends two ropes are passed so as to cross the boards at right angles. The ends of the ropes are brought up on each side of the ball, and fastened to handspikes or bearers for carriage; or the ball, if very heavy, may be placed on a low truck.

Jesse's *Tree-lifter*, described and figured in Loudon's *Encyclopedia of Gardening*, p. 556, is on the same principle as regards lifting as Mr. M'Nab's, only bent irons are employed instead of ropes.

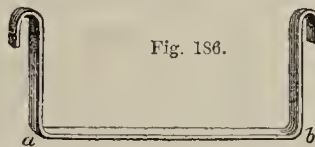
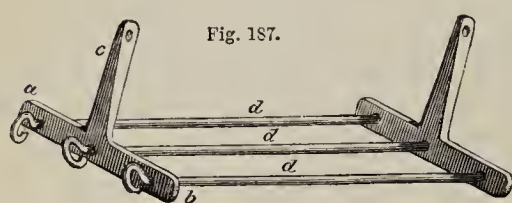


Fig. 186.

It consists of two pieces of iron, 6 feet long, 3 or 4 inches broad, and rather more than $\frac{1}{2}$ inch in thickness, bent as in Fig. 186, so as to reduce the distance *a b*

to 3 feet; but larger dimensions may be allowed if necessary. The two irons are introduced below the tree 2 feet or more apart, according to its size, and the whole is lifted by poles placed under the hooked ends of the irons. Below these poles, which are used as bearers, cross ones may be put, to allow of an additional number of men taking part in carrying the weight.

Mr. Saul's *Transplanting Machine* is on a very good principle, as regards the support given to the soil at the under part of the ball. It consists of two irons, as represented in Fig. 187. Each iron has a horizontal base *a b*, in



Saul's Transplanting Machine.

which there are three holes; and from its centre rises a perpendicular piece *c*, with a hole near its top. These irons having been placed one on each side of the ball, three rods, *d, d, d*, are passed through the holes at the base into the corresponding ones on the opposite side. The tree is then ready for removal. This is effected by means of a sort of truck with a strong pole in front, and hooks attached at its hinder part. The hooks are depressed by elevating the pole till they catch in the holes in the tops of the uprights *c, c*; and when the pole is lowered the back of the truck is of course raised, and with it the tree. The latter, having been firmly secured by ropes, is then conveyed to its destination.

Mr. McIntosh has improved on the above machine by having it constructed with three uprights instead of one. These afford better support to the sides of the ball, and, moreover, the uprights are perforated, so that iron rods may be passed through them to support the other two sides of the ball.

McGlashan's *Small Transplanter*, for removing small trees and shrubs, consists of a square iron frame, one side of which is hinged at one corner, so as to open and allow of the frame being placed on the surface, round the base of the plant to be taken up. The moveable side, fixed at one corner by the hinge, is then secured to the end of the opposite side. Four broad spade-like plates with wooden han-

dles are then driven into the soil on the inside of the frame to the required depth, and an extension rod is passed through each handle into the one on the opposite side. The handles are then drawn outwards, and kept in their new position by pins passed through holes in the extension rods. Now, it is easily understood that, if the handles are pressed out at top, the spades must be pressed in at bottom, and the soil being compressed at that part does not drop away. Bearers are then hooked on to the iron frame, and the whole can be lifted and carried to the hole prepared for the plant. For any shrub or small tree that has plenty of fibres within the space inclosed by the iron frame and spades, this machine answers very well; but where most of the principal roots are beyond the limits above mentioned, it is evident that the plant would by its use be deprived to a great extent of its means of obtaining nourishment from the soil; consequently, it will in such cases be advisable to adopt some other plan by which the extremities of the roots can be saved.

In *transplanting large trees*, a considerable amount of mechanical power and strength of materials are required to raise above the surface of the ground the tree and its roots, together with the mass of earth adhering to them. In removing large trees, two principles have been chiefly acted upon. According to one, the stem of the tree with a strong piece of timber braced to it forms a lever; and on this being drawn down over a fulcrum, consisting generally of an axle supported on wheels, the root with its ball of earth is raised up, and the tree is conveyed, in an inclined position, to its destination. By the other principle, which is that more recently adopted, the tree with its ball is raised perpendicularly by screw power, or otherwise; and this mode is unquestionably the best where there is clear space to move the tree along in an erect position, and even in some cases where the tree must necessarily be inclined after it is taken up, on account of the want of head-room in its course of transit.

The mode of removing trees by means of leverage over an axle has the disadvantage of straining the roots very much; the stem is also liable to be bruised. Sir Henry Stuart employed a machine on this principle in moving a number of large trees at Allanton; but, in the first place, he partially inclined the tree so as to introduce a quantity of soil below

the raised side of the ball; this having been effected, the tree was inclined in an opposite direction, and the other side of the ball blocked up with soil in a similar manner. By continuing the same process, the ball was elevated as high as the surface of the ground, or even higher if desirable, and thus the tree was raised without employing any powerful lifting machine. It is supposed that the ancient Egyptians adopted some mode analogous to the above in raising the immense blocks of stone of which the pyramids are formed. On this subject some interesting details will be found in the *Philosophical Magazine*, 1844, p. 404.

The general mode by which trees are raised according to the principle of a perpendicular lift, is by means of two strong carriages, each mounted on a pair of wheels, and which are made to approach each other within a certain distance of the stem of the tree to be moved. The two carriages are then connected by strong beams, sufficiently high to allow of the ball and roots being suspended below them so as to be clear of the ground. The weight is then transferred by screw power to the beams resting upon the carriages. If the weight consisted of a compact solid mass, the operation of raising it would be very simple; for it would merely be necessary to attach it to screws by ropes or chains of sufficient strength, and then to elevate it by applying whatever amount of leverage might be found necessary to work up the screws. But the tree with its ball and roots does not by any means form a mass so compact; the latter two are below the bearing of the working power, but they are apt to break and give way when pressure is applied; whilst the greater part of the weight of the stem and its branches is above that bearing, and is consequently apt to overbalance. Care must therefore be taken to secure the ball and roots, and to keep the tree steady. Keeping these objects in view, the simplest and easiest mode by which the tree can be moved must be considered the best.

Mr. Barron's large tree-lifting machine consists of two carriages, which when placed at a proper distance from each other, with the tree between them, are connected with two strong oak beams 21 feet in length. An excavation about 2 feet wide is made under the ball or mass, from one end to the other, and as nearly as possible under its centre. In this cavity, two strong poles are laid, and on them, length-

wise, a broad 3-inch plank. In order to give further support to the mass, which is somewhat oblong in form, four bevelled-edged planks are employed; one of these is made to rest across the end of the broad centre plank, another across its other end; whilst the other two are placed one on each side of the mass, and rest on the end of the first two. Cavities between the different planks and the soil and roots, are firmly packed in with litter. Thus secured, the whole is raised by means of screws, with chains attached to the platform. By taking great care of the extremities of the roots, and introducing the platform completely under the centre of the weight to be raised, Mr. Barron has removed large trees with very great success.

Mr. Mackay, gardener to the Hon. E. Strutt, of Kingston Hall, Kegworth, has also very successfully moved large trees on an extensive scale. The principle of his machine is essentially the same as that of Mr. Barron's, but there is the addition of four side, or, they may be termed, corner chains, for there is one at each corner of the platform under the tree. These act as auxiliaries to the two main chains; for, when the screws attached to the latter are worked up, the corner chains sustain the weight till the two main screws are reversed and the chains attached to them shortened, so that the main screws can take a fresh hold, ready for being again worked up. As this is being done, the side chains become relieved of the weight; but when the main screws are worked up to their full extent, the corner chains are tightened, and the main screws are then reversed. The weight is about equally divided between the corner chains and the two main ones. By this arrangement, the weight of the tree and ball is borne with greater steadiness, supported, as it then is, at six points instead of two.

Mr. M'Glashan's large machine is well-constructed as regards power. It differs from several others in regard to working the lifting screws. Instead of these being worked by a lever through a box-screw, fixed in the supporting beams, a box-screw, with levers attached, is turned round on an iron plate, on the upper side of the beam, to work up the screws. The lifting screw, from its not requiring to be turned round, can therefore be attached, without a swivel, to chains or ropes supporting the weight of the ball. But in some respects of great importance, the machine

requires improvement. In noticing the principle of Mr. M'Glashan's small transplanter, it was observed that the extremities of the roots beyond a certain extent were entirely cut off. This is unfortunately the case, but to a greater extent, with his large machine. Although with a large tree 10 or 12 tons of soil, or a ball of the dimensions of 10 feet square by 3 feet deep, may be taken up, yet this would only include the roots within a distance of 5 or 6 feet from the stem of the tree; and, in a large tree, most of the feeders are beyond that distance, and are consequently cut off. This will readily be understood when it is explained, that strong iron plates, 3 feet long and 1 foot wide, with a short round iron stem and pummel-shaped top, are driven in as far as the top of the plates, along the inside of a strong iron frame, about 10 feet square. Iron bars are then placed against the iron handles of the spades or plates, just below the pummel-tops, and these are forced outwards by means of extension rods, whilst the plates are consequently pressed inwards.

Now, on a small scale, the principle will act tolerably well. With Mr. M'Glashan's small transplanter, for example, the soil is compressed so that scarcely any will drop from the bottom of the ball. But it is well known that beyond a certain thickness earth cannot be compressed, nor affected in any way, even by the force of a cannon ball; and we believe that if an egg were inserted 2 or 3 feet deep, at or near the centre of a mass of earth, 10 ft. sq., and which is acted upon by the lower part of iron plates inserted 3 feet deep, and 5 feet from the centre of the mass, no breakage would take place, in consequence of the pressure so produced. The pressure, exerted by the lower part of the plates, would probably affect the mass of soil very little more than 1 foot inwards on each side, and certainly not so far as to prevent the soil towards the centre of the ball from dropping when the mass is lifted up. This we know to be the case when the soil is of a loose nature. The principle is good as regards the raising and retaining a mass of soil of small size in a compact state; but beyond this it loses ground. Double the screw power will lift double the weight in any case; but double the grasping power, as that resulting from the action of the extension rods may be termed, will not compress the soil towards the centre of a large mass half so much as if half the pressure were exerted on

half the mass; so that the latter may be increased till the arrangement can be of no avail as regards the retention of the soil near the centre of the bottom of the ball.

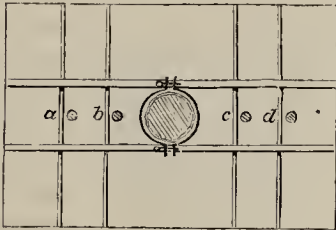
Two beams are laid, one on each side of the tree, at some distance from it, and so as to rest upon the frame, to which they are then secured by strong chains. Two other beams are laid across these, one on each side of the stem, and close to it. Two pieces of broad and thick bar-iron, bent in the middle, so that when put one on each side of the tree they form a clamp, are placed very closely down upon the cross-beams, and screwed tightly round the stem of the tree, which, of course, should be protected at that part by several folds of matting or other soft material. Chains are put round the ends of the two lower beams, and connected with the lower ends of the screws which pass through the bearers of the machine. When the screws are worked up, the lower beams are raised, and all that is connected with or dependent upon them—namely, the iron frame, the two cross-beams, and the clamp surrounding the stem, which, of course, cannot rise without bringing the tree along with it. In fact, if the iron clamp or collar were strong enough, and made sufficiently tight, the tree must rise, whatever quantity of torn roots and soil might be left behind. When screwed up till suspended high enough to clear the surface, the machine is set in motion, and drawn over the hole prepared for the tree; the screws are reversed, and the ball is gradually lowered till it rests upon the soil at the bottom of the hole.

Mr. McIntosh suggests some very judicious improvements in this machine. We fully agree with him in recommending the roots to be saved, as much as possible, by digging a trench, and undermining the ball in the usual way. He says, "When the ball is thus prepared, if broad grippers, in form like the letter **L**, were introduced along the sides of the ball, just as Mr. M'Glashan's cutters are, but not quite so close together as to prevent the roots which extend beyond them from passing between them, the turned-in ends of the grippers made to pass under the ball on all sides, the extension rods attached to them, and the **T**-iron placed as in his method, the ball would be kept together not only at the sides, but under the bottom likewise. The operations of lifting should be exactly as re-

commended by the patentee; for of all modes hitherto employed, none are so simple and effective as his. The turning in the ends of the grippers below the ball would prevent the soil from falling away from below; and the ball being prepared as in ordinary cases, this transplanter could be employed in all soils, however stony or gravelly, which at present it cannot be, on account of the moral impossibility of driving in the cutters amongst stones and gravels."—(*Book of the Garden*, vol. ii. p. 385.) This, which Mr. McIntosh designates a slight modification, we think a great improvement, which the patentee would do well to adopt.

The following is a simple plan, which, it is presumed, might be advantageously adopted in transplanting large trees; and we are not aware that it has hitherto been proposed. Let Fig. 188 represent the surface of the mass to be raised,

Fig. 188.



with the tree in the centre. With a crowbar make holes along the centre, as at *a, b, c, d*, say $3\frac{1}{2}$ feet deep, and $2\frac{1}{2}$ inches wide.

The holes may be shifted a little, if strong roots are in the way; but, in most cases, the crowbar can be inserted without any material injury to the roots. In the holes made by the crowbar, insert strong iron rods with an oblong slit near the bottom, like the eye of a needle, but large enough to admit a bar of iron edgewise. The slit may be 8 or 10 inches long, and the top of each rod may have a strong threaded screw worked down 1 foot; or it may be formed with an opening, as in the lower end, to admit a bar of iron. The mass should then be undermined on both sides, nearly to the centre, and four bars of iron introduced through the lower ends of the rods; on these bars a flooring of planks should then be laid, packing being equally introduced between the planks and the mass of soil and roots. This being done, poles ought to be laid on the surface, as at *a, b, c, d*, across the direction of the line of the inserted rods; and above these poles, two strong beams, transversely. These should be tightly pressed down by the horizontal extension of the ends of a collar or clasp, fixed round the stem of the tree, and by cross pieces of wood or iron

worked down by nuts adapted to the top of the upright rods, if these are screwed, or by wedges, if eyed. This will have the effect of drawing up the rods; and, consequently, the bars with the flooring will be brought up very close to the base of the mass. Moreover, by means of rods of iron, pieces of wood, or chains, the ends of the poles *a, b, c, d*, can be firmly braced to the ends of the bars directly below them. Pieces of wood and packing can then be put along the four sides, so as to render the whole a compact mass, ready for lifting. This can be effected by screw power, applied according to the modes already mentioned, or otherwise, as may be found most convenient.

Planting Large Trees.—Previous to removal, a hole or pit ought to be prepared for the reception of the mass of soil and roots moved with the tree. It should be made so that the tree may be nearly as deep in the soil as it was before, making allowance for sinking; and its length and breadth must be ample. The tree may be drawn to its new situation either by horses, or more steadily by oxen, or by a windlass with ropes and pulleys. It will be advisable to lay down planks for the wheels of the vehicle wherever the ground or roadway is not so firm as to prevent the wheels from sinking; and properly supported planks should extend right across the hole, and so that the ball of the tree can be brought right above its centre. When this has been effected, the tree should be gradually lowered, which may generally be done by reversing the process of lifting. The greatest difficulty now is, the withdrawal of the planks from beneath the ball; for, if the mass were allowed to settle down, planks or poles would not easily be got out. Mr. Barron adopts a very good plan for obviating this difficulty. He rests the bottom planks upon props, and then fills up the cavity below the roots with soil, which supports a great part of the weight, so that when the props are removed, the planks can be drawn out. This having been effected, the side roots should be carefully spread out, and the soil worked in amongst them. When a layer of roots is covered with an inch or two of soil, water should be given from a watering-pot with a coarse rose, and, if poured from a good height, so much the better. If water cannot be made to act directly in this way, an engine with a flexible hose may be used. As soon as the water has subsided, more soil may be added for a fresh layer of roots, and so on

till the whole is covered. The hole should then be filled with loose soil, which ought to be raised at least 6 inches above the level of the adjoining ground, and, if still higher, it will tend to steady the tree. The latter should, independent of this, be well secured from being shaken by the winds, otherwise fresh fibres would be liable to be broken as soon as formed. Three poles, disposed in form of a triangle, or rather a triangular pyramid, will form a most efficient support, from whatever quarter the wind may blow.

CHAPTER XIV.

PRUNING.

Pruning is the cutting off or otherwise severing some portions of the stem, branches, shoots, leaves, or roots of a plant. The object of doing so is to regulate the vegetation of the plant by removing growths that are worse than useless, or which would become such if allowed to proceed unchecked. When trees are subjected to artificial treatment, pruning, in most cases, becomes indispensable. For instance, a tree in its natural state forms a top with branches which are free to point in all directions; but, when trained against a wall, they are limited to a flat surface representing the section of a hemisphere, on which it would be impossible to dispose the branches of the naturally formed top, without overcrowding them. But when a tree is planted in good soil, and otherwise favourably circumstanced for making a luxuriant growth, as it cannot push in all directions, it will push the more vigorously where it can. If it is prevented, by a wall, from pushing on one side, the well-fed buds will, nevertheless, push and produce a superabundance of shoots towards the other side; no more, indeed, than the roots would be able to feed, but more than twice as many as could have their foliage duly exposed to light. To expose the foliage well to this essential agent, is a most important object in cultivation, and which, in this as well as in many other cases, can only be attained by pruning.

The effects produced by pruning are various, and depend on the nature and condition of the subject, as well as on the time and manner of the operation. As the growth of a

plant depends on the amount of foliage duly exposed to light, it is evident that any reduction of the branches or shoots which bear the leaves must tend to diminish, in the first place, the rate of increase in the bulk of the plant generally; but, in consequence of removing certain parts from a plant, those that are left make not only a larger, but likewise a more substantial growth, from having a greater share of sap, and from being better exposed to light, so that, ultimately, a larger and much stronger plant results from judicious pruning than would otherwise be the case. The immediate effect of pruning is to encourage a greater flow of sap towards the parts which are left. Thus, if a shoot is shortened, as at B, Fig. 189, the sap which would otherwise flow in the part above B, will go to the increase of the other parts, and especially to the shoots A and C; and if the shoots B and C are both shortened, a still

Fig. 189.

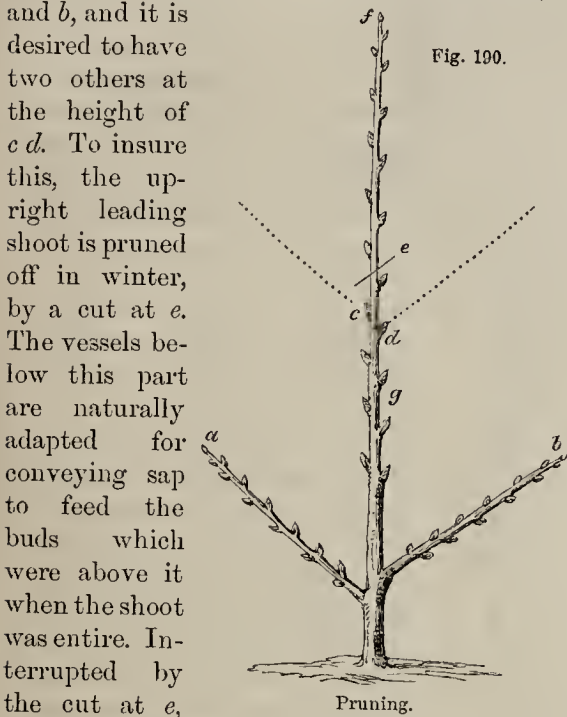


Pruning.

greater force of sap will be directed to the centre shoot A. Here, it may be remarked that, when the shoots had grown only so far as to reach but little above the points c and B, and when these points would, consequently, have had the same relative situation with reference to the growing point, as at E and D, a practised observer would have instantly seen that these shoots would be competitors with each other and with the central shoot A; and, this being the case, he would not have

hesitated to pinch off the extremities when these reached no higher than c and B. By so doing, the central shoot A would have been stimulated at an earlier stage of its growth, and, consequently, would have been taller by the end of the growing season, than it would by sharing longer the flow of sap with its two powerful rivals. Whilst the greatest immediate effect of shortening the two side branches at c and D, is to throw the largest portion of the sap which can no longer pass above those points into the central stem A, yet the whole will not be diverted into the channels of that

part. The leaves on the remaining part of the two branches B and c will be expanded; more sap will be elaborated by them; the buds in their axils will swell, or some of them may even push into shoots in the same summer, and, whether this be the case or not, the buds in the axils of the leaves below B and c will be more plump than they otherwise would have been, and will be more disposed to become fruit-buds. By taking advantage of this tendency of sap when interrupted to flow with greater force into adjoining parts, shoots can be obtained almost wherever we please. For example, in Fig. 190, there are two shoots, *a*



and *b*, and it is desired to have two others at the height of *c d*. To insure this, the upright leading shoot is pruned off in winter, by a cut at *e*. The vessels below this part are naturally adapted for conveying sap to feed the buds which were above it when the shoot was entire. Interrupted by the cut at *e*, the force of the sap is exerted on the adjoining parts, and the three buds immediately below the section are almost sure to push into shoots, as represented by the dotted lines; the uppermost bud left, that immediately below the section, supplies the upright leader, and the two next lower furnish the two side shoots which are desired. Had these been required lower, they might have been obtained in a similar manner, by cutting lower down, as at *g*.

In the same way, it is evident that if shoots were required to commence the formation of a head immediately below the point *a*, Fig. 191, they would be obtained by cutting off the top of the upright shoot at that point; but, in that case, it is presumed that a clean stem will be required from the ground up to the shoots so produced, and the question is, By what mode of pruning will this best be

obtained, seeing that there are a number of branches proceeding from the stem between *b*



and *i*? The obvious way would be to cut off at once all those branches, as has been too long practised in such cases, without the slightest hesitation, either in spring, summer, or winter. That this, however, is not the proper mode, will appear from a consideration of the consequences. It should be borne in mind that all these shoots are in connection with the roots; that there is a reciprocal action between the growing parts above ground and those below ground; and that the roots supply nourishment, or the

raw materials to be manufactured by the leaves, whilst these return substances for the extension of the roots in quest of more food. On all the branches between *b* and *i*, there would be a greater aggregate breadth of foliage than between *i* and *a*; therefore, if these branches were entirely cut off in the growing season, the growth of the roots would be proportionably checked. If, on all the shoots between *b* and *i*, there should be 100 leaves, and only twenty-five between *i* and *a*, and if the former were at once removed, the roots of the plant would be suddenly deprived of four-fifths of their means of growth. This privation would prove too severe a check to the roots, and weaken, to a very injurious extent, the vegetative powers of the plant; and although the buds immediately below *a* may freely appropriate all the sap, yet that will be a very limited amount. Such being the case, it is evident that a different mode of proceeding from cutting off so many shoots at once must be adopted. Supposing that the plant is in a healthy growing state, we may deprive it of a small portion of foliage without injury, and, in a short time, the expanding foliage will make good the deficiency. As soon as that is judged to be the case another portion may be cut off, and so on. Thus, again referring to Fig. 191, we may cut off the lower branch close to the stem, as at *b*, and the two

next shoots may have their points pinched or cut off at *e* and *d*. The loss of the few and imperfectly developed leaves taken off with these points will not materially affect the roots, although, at the same time, the flow of sap previously directed towards them, being checked, will tend to pass into the upright shoot, and its remaining laterals, and will more rapidly expand the foliage which these bear, so that the aggregate expanse will soon be greater than it was at the time the lower shoot was cut off at *b*. When that is the case, the two shoots stopped at *c* and *d* may be cut closely off, as at *e* and *f*. The remaining side shoots had better be allowed to grow untouched during the season, with the exception of pinching the tops of one, two, or more of them, if they appear to grow too vigorously. The action of the leaves they bear will assist in healing over the wounds at *b*, *c*, *f*, strengthen the lower part of the stem by the layer of alburnum which will be deposited from the sap elaborated by their foliage, and form a greater proportion of roots. At the autumn or early winter pruning, these shoots may all be cut clean off; and the buds above *i* will swell boldly and push vigorous shoots. If the leading shoot had been stopped at *a*, in summer, lateral shoots would have, doubtless, been produced; but if the leader had been allowed to proceed with uninterrupted growth till the end of the season, and had been then cut at *a*, much stronger and more substantial shoots would have been the result. By the gradual and gentle process above detailed, the obnoxious side branches are removed without any shock to the general vegetation of the plant, as would certainly have been the case had they been cut off in the growing season, all at one time. It has thus been shown that, although the effect of pruning is to throw more sap into the adjoining shoots, yet when the operation is carried to too great an extent, and a large amount of foliage removed at one time, the vigour of the whole plant must be greatly reduced.

As by pruning a stem can be made to diverge into branches, so, on the other hand, when a single stem is the principal object desired, that can be insured by judicious pruning. Various kinds of trees will sometimes grow with single straight stems to the height of 50 or 60 feet, or more, and afford useful timber; but they will occasionally branch out near the ground, and form, instead of a stately

tree, a sort of huge bush. Probably, in this case, quite as much wood will be formed in a certain number of years as if the tree had grown with a single stem; but comparatively

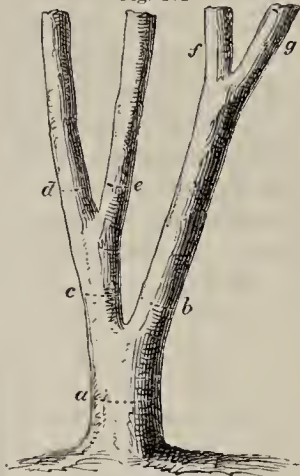
little that can be reckoned timber will be obtained from a tree which chiefly consists of ramifications.

Fig. 192 represents the stem of a tree, the pruning of which has been neglected in its youth, and it has consequently subdivided into the branches *b* and *c*, and the latter again into *d*, *e*, *f* and *g*. The following dimensions are from actual measurement:—

Circumference at —	Diameter.	Area of Section.	Side of Square.
<i>a</i> = 78 ins.	24.838 ins.	484 sq. ins.	17.5 ins.
<i>b</i> = 61 „	19.417 „	296 „	13.7 „
<i>c</i> = 45 „	14.318 „	161 „	10.1 „

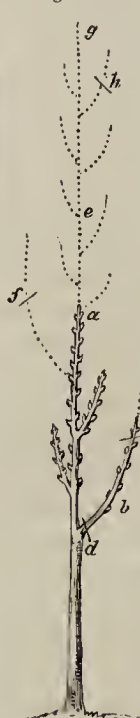
From the above it appears that the area of the section of the two forks at *c* and *d* is nearly equal to that of the stem at *a*, but then there is very little useful timber. The stem is of large dimensions as regards thickness, but it is only $3\frac{1}{2}$ feet in length. The limbs *b* and *c* are of tolerable size, but their length is, respectively, $8\frac{1}{2}$ feet and $3\frac{1}{2}$ feet. After the subdivisions of these limbs at *d*, *e*, *f*, *g*, we have only large branches scarcely coming under the denomination of timber. Now, when the tree was young, and the extremity of its central leader was at *a*, Fig. 193, that leader had a competitor at *b*, which should have been stopped, as at *c*. In the following season, the part between *d* and *c* might have been allowed to have borne foliage to strengthen the lower part of the stem and the roots; but, presuming that a clean stem was desired, that branch should soon have been removed, and therefore its vegetation ought to have been kept in check

Fig. 192.



Neglected Pruning.

Fig. 193.



Pruning.

and when there was an abundance of leaves above it, or of shoots to bear such, it might have been cut off close to the stem at *d*, and thus a limb, such as that at *b*, Fig. 192, would have been prevented from growing. On again referring to Fig. 193, it will be seen that, when the upright stem had attained the height of *e*, it was threatened with a competitor, which should have been checked at *f*, otherwise, instead of a continuation of a clean stem, two limbs, such as *d*, *e*, Fig. 192, would be formed. When the upright leading shoot was as high as *g*, a shoot likely to prove too strong for it should have been stopped at *h*. Thus, by a few slight cuts, *c*, *d*, *f*, *h*, the ramifications seen in Fig. 192 would have been prevented. By following up the system of checking rivals to the leader, and by gradually reducing and clearing away successively the lower branches of the tree, a single clean stem of solid timber, like that represented in Fig. 194, will be the result. By the check at *c*, Fig. 193, and subsequent removal of the lower branches at *d*, the formation of such a strong limb, as at *b*, Fig. 192, is prevented, and the other ramifications, *d*, *e*, *f*, *g*, by stopping the shoots having a tendency to form such ramifications when the tree is young, as at *f* and *h*, Fig. 193.

Although straight timber is much in request, and thick, single stems are more valuable than the same bulk in the form of limbs and branches, yet, for particular purposes, bent or knee'd timber is required. It is true that such as is grown straight can now be bent by powerful artificial means; but it is questionable whether it is then so strong

as that which is grown to the required form.

There are three ways of obtaining knee'd timber:—1st. By selecting a strong limb, as at *b*, Fig. 195, diverging naturally from the upright trunk *a*. 2d. By pruning off the central upright leader at *b*, Fig. 196, so that the whole flow of sap may be directed into the shoot *c*. 3d. By bending the central shoot, when one or two years old, and keeping it in the position to form the required bend. From inspection of the figures, it is evident that the knee formed by the natural divergence in Fig. 195 cannot be so strong as that represented in

Fig. 196, for this reason—the woody fibres of the limb *b* continue downwards to the root, chiefly on the same side of the stem as that from which the branch proceeds, whilst the

rest of the trunk is made up from fibres descending from *a* *c*. After the cross cut *d* has been made, if, from drying, a rent should commence in the top of the cross section *d*, the knee'd

portion might easily be separated somewhere by the dotted line. In Fig. 196 we have the

young plant *c* increasing in thickness, say to the dotted lines. The fibres of the wood are

bent as they are formed, but everywhere uninterrupted; the knee cannot split across the top of the

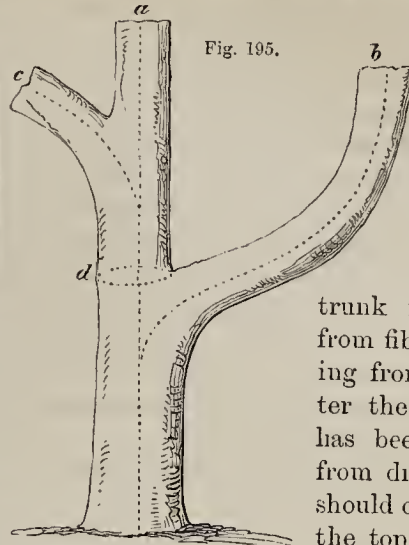
bend as in the other case; for the cross fibres must there be cut or broken across.

To obtain a knee'd piece of timber in which the woody fibre, although bent, is nevertheless conti-

nuous, and consequently insuring the greatest strength, as in Fig. 196, it is best either to bend the young one or two year old part of the stem, or to prune the upright *a* above a suitable diverging branch *c*. The small sectional wound at *b* is soon healed over, and the continuous course of the woody layers is but little interrupted. Perpendicular shoots will be apt to push from the upper side of the horizontal part of the bend; but such must be kept closely pruned off.

The effects of pruning will be understood to be:—

1st. Checking the growth of certain parts

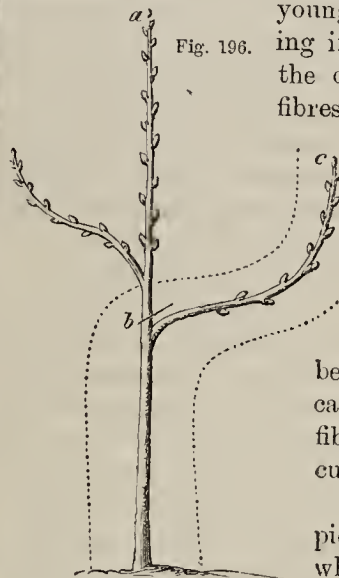


Pruning for Knee'd Timber.

Fig. 194.



Pruning—Clean Stem.



Best Mode of Pruning for Knee'd Timber.

where that is necessary, and promoting it in others, as shown in Fig. 189.

2d. Stimulating buds to push which otherwise would have remained dormant, as at *c*, *d*, Fig. 190, by removing a portion of a plant, so that the sap may flow with greater force, and in greater abundance, into the adjoining parts.

3d. The production of a clean straight stem, as in Fig. 194, by judiciously stopping, and pruning off a number of superfluous branches, an operation which can be performed in such a manner as not to materially affect the growth of the plant.

4th. The production of knee'd timber, as in Fig. 196, by the application of the same gentle means when the tree is young.

From these illustrations it is presumed that the general effects of pruning will be readily understood. We may therefore proceed to enumerate its principal objects. By pruning, trees may be made to receive a form and proportion different from that which they would assume if left to themselves. Thus, trees that naturally grow with large heads elevated on tall stems can be made to form a head near the ground, as is done with the pear, apple, plum, cherry, apricot, &c. On the other hand, some plants that are naturally dwarf and bushy can be formed so as to have a moderately tall stem, as, for instance, the gooseberry and currant.

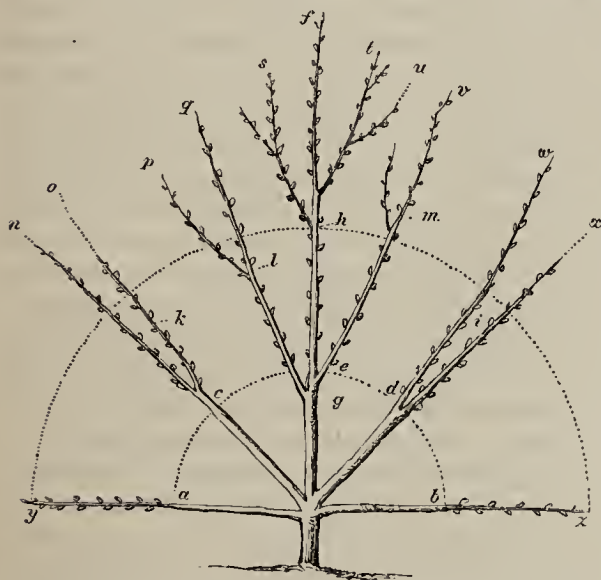
The exposure of the foliage to light should constantly be kept in view. It is especially necessary in trees subjected to dwarf training. The more the growth of a tree is diverted from its natural form, the more it is disposed to throw out a greater amount of shoots than can have a due amount of light. Pruning then becomes absolutely necessary, as in the case of wall-trees. By reducing, to a certain extent, the number of shoots, more nourishment is supplied to the remainder. Instead of a certain amount of nourishment being distributed sparingly amongst a number of branches or shoots, the same amount may be concentrated among a few, which will consequently be rendered much more vigorous than they would have been had the whole supply of sap been divided into many shares. On these comparatively few, but well-fed shoots, cleared from spray, larger leaves, buds, flowers, and fruit are obtained.

The proper time for performing the operation of pruning varies according to the nature of the subject, and the object in view. In

general, in the case of deciduous trees, it should not be performed when the buds are bursting, or nearly so, in spring, for then the sap is in active circulation, and if suddenly checked, the plants are apt to bleed and die, or become greatly weakened. We have seen a nursery row of vigorous apple trees which had been grafted several years, cut down nearly to the ground in autumn. These, in the following season, pushed shoots upwards of 5 feet in length. In the other part of the row no such growth was desired, some shoots, merely to preserve the sorts, being all that was wanted. With this limited view, the plants were cut down, just when bursting into leaf. The consequence was, in the course of the summer, instead of vigorous shoots, like those resulting from pruning down in autumn, weakly growths were made, the shoots not exceeding 18 inches in length. These trees were of naturally strong-growing, cider varieties. This shows how important it is to prune at the proper time. Supposing that the plants treated as above had been intended for standards, good stems would have been obtained from those cut back in autumn, and very bad ones from those subjected to similar treatment in spring. Rather than cut too late in spring, when vigorous growth is the object, it would be advisable to defer the operation till the following autumn, and encourage the trees to make good foliage, and, consequently, good roots, during the summer. A little summer pruning may be performed, when, by so doing, better leaves can be insured, more efficient from being better exposed, fewer, but not presenting a less aggregate surface to the light. From the above instance, as well as from many others, it is a well-established fact, that, by pruning in autumn or winter, before the sap has swelled the buds in the upper parts of the plant, we obtain, generally speaking, strong shoots in the course of the ensuing season; on the contrary, if we delay till the sap is in active circulation, and then cut back the plant, we certainly weaken its powers of vegetation, and, in many cases, induce disease. The sap is not only too suddenly checked, and its circulation deranged, but its quality becomes altered, especially at and for some distance below the wound. We may be convinced of the altered quality of the sap by cutting the branches of a vigorous apple tree when the buds are breaking, the weather warm, and the sap in full flow. Then, after

a week or so, take off a slice of bark below one of the wounds, and as deep as the alburnum, and another slice from a branch not cut back; the two will smell very differently; and it will be found that the sap of the amputated tree has become vitiated and sour, if not putrescent. The vitality of the cambium is destroyed for some distance below the wound, and a dead or cankered stump is the result. As pruning after active vegetation has ceased in autumn, results in the production of vigorous shoots, and as, in cultivation, excessive vigour has to be modified, the question is, How is this to be best effected? It is evident, from what has been already stated, that although pruning, when the sap is in full flow, and before the leaves expand, has the effect of diminishing the general vigour of the plant, yet the constitution of the plant is, at the same time, injuriously affected, and therefore this mode is highly objectionable. Recourse must be had to summer pruning, which, if judiciously performed, will have the desired effect. By this means the vigour of the whole, or of any particular part, can be reduced, or limited, without impairing the constitution of the tree. If the branches of a young tree are cut back in autumn to an equal length, as at *a, b, c, d, e*, Fig. 197; and supposing

Fig. 197.



the branches, when so cut back, are all of equal strength, they will, notwithstanding, grow very unequally. Most sap will naturally flow into the most upright branches. In such a case, the growth resulting from either of the cuts *c* or *d* will alone equal or even exceed that of both *a* and *b*; whilst the upright

shoots, from the section at *e*, will sometimes make more growth than all the others put together. The horizontal branches at *a* and *b* push each a single shoot; from *c* and *d* two shoots proceed from each; whilst the three buds immediately below the section *e*, push into shoots which occupy the best position for receiving the principal flow of sap; and, at the end of the season, the superiority of growth in the central portion of the tree, as represented in the figure, will not be found to be exaggerated. If the shoots were again pruned before winter to the limit of the second dotted line, and if the excess of growth in the central part proceed in the same ratio, it is easy to perceive that a comparatively small share of sap would go to the support of the two horizontal branches proceeding in the directions *a* and *b*.

In order to prevent the more upright parts from becoming too strong for the horizontal ones, summer pruning must be resorted to; for, by autumn pruning, say to the other dotted line, the sap which would have been required to supply the buds above that line will be concentrated to stimulate the buds situated immediately within it, and especially those resulting from the section at *e*. A rush of strong shoots from these would be the consequence. Some have said of such shoots, "Let them grow and exhaust their over-vigorous disposition;" but that will not do; for the stronger they grow, the more alburnum they form, and of course the more vessels for the ascent of sap. If, therefore, we could prevent the formation of alburnum in any part, we would, at the same time, diminish the flow of sap, and consequently reduce the luxuriance of that part. This can be done, to a greater or less extent, by summer pruning. Let us now return to the tree as it was cut at *a, b, c, d, e*; and supposing that the object is simply to check excess of vigour in the centre of the tree, the shoots pushing at *e* should be watched, and only one allowed to grow unchecked for the present. It may be the central one. The other two ought to be pinched when about 4 inches long; and, soon

after, at short intervals, first one, and then the other, should be cut clean off. When the one left reaches *h*, it should be stopped; a lateral will then likely push, and if so, it must also be kept in check, by always shortening to a few buds. The shoots from *c* and *d* should, in a like manner, be reduced to one

from each, and ought not to be allowed to grow to a greater length than those proceeding from *a* and *b*. By timely stopping, none of the shoots pointing to the letters, from *n* on the left, to *x* on the right, would be allowed to exist, except three, namely, those in the direction of *n*, *f*, and *x*. The two lower branches, favoured by the checking of the others, will grow longer than represented in the figure; and whatever their length may be, the other three may be allowed to extend nearly as far in the direction *n*, *f*, *x*. If, during the summer, all the shoots in the direction of *y*, *n*, *f*, *x*, *z*, have an equal quantity of foliage, and that equally efficient, the strength of the shoots at the end of the season will also be equal. We may limit the extent of the foliage by stopping or summer pruning the young shoots. This can be done without injuring the healthiness of the foliage on the part of the shoot left, and, that being the case, that part of the shoot must also be healthy. A great amount of vigour can, therefore, be repressed by means of summer pruning, without injuring the general health of the tree.

Having shown how the object proposed by pruning can be accomplished, it may now be remarked, that, by the aid of training, the balance between the strength of the upper or horizontal branches can be maintained with less cutting back than is necessary when that is effected wholly by pruning. The effect of lowering and raising shoots will be explained more practically when we come to training; but till then we shall suppose that by maintaining the shoots *yz* in an elevated position, that is, one more favourable to growth, the other branches may be allowed more scope, but still the central force will require to be kept more or less in check. We may therefore show how this may be done, especially as the figure is well adapted for illustrating various points connected with summer pruning.

The central shoot *f* may be cut off, leaving *s* and *t* diverging, unless an upright leader be required; then *f* may be cut as low as *h*, and *s* can be taken upright in the place of *f*. Soon after this, the shoot proceeding in the direction of *g* may be cut off at *l*; and, at the same time, to balance this the shoot *v* should be cut at *m*. The shoots *n* and *x* may be allowed to proceed, but it will be observed, that *w*, springing from the upper side of the branch at *d*, and profiting by its more elevated position, has taken the lead, or, in other words, is fast

gaining an ascendancy over the intended leading shoot *x*; and the shoot *o* would do precisely the same thing with regard to the shoot *n*, but it will be observed that *o* is checked by being stopped or cut back, as at *k*; and *w* should have been stopped in a similar manner. In practice, shoots having the same relative position as *o*, *n*, and *w*, *x*, will be very frequently met with. The consequence of not interfering with these will be understood by referring to *w*, *x*; whilst this is borne in mind, the mode of dealing with such cases is exemplified by the check given to the upper shoot of the two, as at *k*. By the end of the growing season the shoot *n*, from having its rival *o* checked at *k*, will be stronger than *x* with its rivals unchecked. Again, the lower part of *w* will be stronger than that of *o*. The strength of each would be in proportion to the amount of foliage they respectively bore; and it will be readily observed that *w*, left free during the summer, would bear much more foliage than if restricted. The latter will be kept somewhat weaker than the leader *n*, which will be in a condition to take the lead in the following spring, without danger of close competition from *o*, for some time at least.

On the other hand, *w* and *x* are not fairly matched. If we estimate the number of leaves on *x* at twenty, and on *w* at thirty, the flow of sap will be one-third less towards *x* than to *w*. Both shoots may be pruned to an equal length at the winter pruning, say to the outer dotted line; but then the buds on the upper one would be stimulated by all the sap, which, had the shoot been unpruned, would have flowed to supply thirty buds, as originally found on that shoot; while the shoot to *x* would only have the proportion of sap necessary for twenty buds, the difference being as three to two in favour of the upper shoot. This should be borne in mind; for, to enable the shoot *x* to overcome this disparity, recourse must be had to pinching, to the pruning-knife, or to both, in the following summer. But it would have been better if the disparity had been prevented in the previous season, as is represented to have been done in the case of the shoot *o*. It should always be remembered, that by a little timely interference, as at *k*, much warfare with the knife is afterwards rendered unnecessary. This is one of the most important principles of pruning, and should be applied with the greatest assiduity; for it is certain that large wounds cannot be inflicted on a tree

without injuring, more or less, its constitution. All the branches of a tree may, it is true, be cut back, and a new and more vigorous top may be the result. But when a tree is composed of parts, some of which are far too strong, and others much too weak, then, when the strong have to be cut out, the tree must suffer. It can neither be so healthy nor so fruitful as one that has its vigour equally distributed. All the branches of a tree may be too strong, or all of them may be too weak. Perhaps in neither of these cases is the pruner to be blamed; but when we see, in the same tree, some branches too strong, and others too weak, then he cannot be free from blame, for pruning must either have been neglected, or it must have been injudiciously performed.

The bad consequences of unskilful pruning, as regards both fruit and forest trees, are incalculable. Many of them may be avoided by attending to the explanations already given. In the case of fruit-trees trained as dwarfs, we have not only to prune so as to keep the branches thin, in order that the foliage and fruit which they bear may be duly exposed to light, but we must, at the same time, endeavour to divert the flow of sap into the lower branches, otherwise these would become too weak; for the sap will still naturally tend with greatest force to the highest branches, so long as the tree is not permitted to attain its natural height. We have shown how this disposition may be checked; and that, as it should be, by the most gentle means. With regard to forest trees, this diversion of the sap into the lower branches is not generally requisite. On the contrary, the object is, in general, to direct it so as to form a tall and thick central stem, in which as much wood as possible should be concentrated; and, of course, the less there is in the limbs and branches the better. But here we must not be led away by the idea that, in proportion as we reduce the branches, we shall increase the stem; for such an idea, if followed out, would prove most fallacious. The bulk of the stem has passed in a fluid state through the leaves, and the matter for its further increase must likewise pass through successive sets of these organs. This must be constantly kept in mind in pruning. And, as we must have leaves, there must be branches to bear them. The difficulty in the operation of pruning for timber consists, therefore, in determining the proportion of branches necessary for the above purpose. For, it is evident,

that if we deprive the stem of all branches, except perhaps a few at the top, we deprive it of the means by which are elaborated the substances for forming the stem, and not only the stem, but the roots also; and without roots we cannot obtain that nourishment, in the absence of which, even the leaves themselves cannot exist. We must therefore promote the growth of leaves as much as we possibly can, without encouraging the production of large limbs, when a clean stem only is desirable.

It should be a rule never to cut off a vigorous branch without first reducing its vigour. If, when a clean stem is desired, a lower branch stronger than those above it is seen, that branch should be immediately checked by the modes already explained. Whilst being reduced, the sap which it would otherwise have appropriated, will find its way to the higher branches; and they will, consequently, grow more rapidly. When the branch is much reduced, it may then be entirely dispensed with. If the lowest branches are, on the contrary, weak as compared with those above them, their loss will be but little felt; and they may be at once cleared off.

If among the branches springing above the lower ones, but still from the part intended to be ultimately clear, one or more branches should exhibit signs of much stronger growth than the generality, they ought to be checked at an early stage; for then it can be easily done by one or other of the modes represented in Fig. 197. On referring to Fig. 198, we find



nothing objectionable in the branches, except the one at *e*, but that one has evidently been allowed to become too strong. An obvious consequence is, that the tree does not taper

regularly, being abruptly much smaller above the branch than below it, where it has all the increase due to the great amount of foliage which the shoots of that branch have successively borne. This irregularity of taper would have been prevented had the branches *d*, *e*, *f* been equal in strength to those on the other side, and to each other. Of the whole amount of sap which has flowed above *a* and *f* into the four branches seen above these, it may be fairly estimated that as much has gone to the branch *e* as into the other three. If that branch had been judiciously checked, so as to be on an equality in point of growth with the others, the sap would have flowed equally into all. The superabundance which went to *e* would have partially increased the strength of all the others represented, and part would have passed on to stimulate the central leader and other parts above *c*. The small branch *f* should be cut off immediately, for the stem below it is not required to be thickened to a still more disproportionate extent by its agency. Then the removal of *e* has to be encountered, and this requires some consideration. It has contributed to the formation of a great portion of the bulk of the stem; whilst it remains, all the vessels and woody fibre which it has formed maintain a connection with it. If at once severed close by the stem, these vessels may empty themselves, but their contents supply no healing matter for covering the wounds, for that can only be furnished by the agency of the leaves. Or, if the fluids do not overflow, they must remain stagnant like so much water, and are likely to ferment. The wood is in consequence discoloured, and decay frequently ensues, extending from the wound down the stem, even to the roots. Instead of closely cutting off the branch at once, it must be gradually reduced till very little sap move towards it. This reduction may be effected in two ways. The mode usually adopted is called foreshortening. The branch is cut off, as at *g*. The lateral branches below this are allowed to vegetate, but they should be checked if they are disposed to push into strong shoots, which they will be apt to do in the first instance, from the flow of sap destined for the supply of the whole branch being directed towards them. Next season, a limited supply, suitable to the reduced state of the branch, will come forward, so that, if the latter were previously cut off, little derangement would take place, and the timber would remain

sound. If as much vegetation is permitted as will merely keep the parts alive, the base of the branch *e* will scarcely increase in thickness, neither will it rob the other branches of the sap to any serious extent; therefore, it need not be cut off close till the second year, and then it will heal still more soundly. But, instead of by foreshortening, the same object may be attained by depriving the branch of its laterals from the base almost to its extremity, leaving just as much as will draw a little sap to maintain life in the branch. For example, the three next the base and on the lower side may be pruned clean off. As the one on the upper side is rather large, it may as well be cut back, at first only to its lowest lateral. The one immediately below *g* should be cut close. With the exception just mentioned, there will be left only the three terminals *h*, *i*, *k*, which can be likewise partly reduced, as may be found necessary. In autumn all may be cleared off except *h*; and in the autumn following, the branch may be safely cut off close to the stem.

Our limits do not permit us to enlarge further on this subject, respecting which, it is presumed, enough has been said to enable any one to understand the general principles; and knowing these, it will be easy to comprehend the details into which it will be necessary to enter in treating specially of the management of the different kinds of trees usually cultivated. In connection with the subject of pruning, two operations, namely, *ringing* and *root-pruning*, may be briefly adverted to.

*Ringin*g.—This consists in cutting a ring of bark from the stem or branches of a tree. The breadth of the ring should not be wider than can be healed over, if not in the same season, at least in the one following that in which the operation is performed. The incision should be made through both the outer and inner bark, penetrating, therefore, as far as the alburnum. As the crude sap rises through the vessels of the wood, and mostly through the youngest layers, it will still do so, notwithstanding the removal of a portion of the bark; but after passing upwards by the vessels just mentioned, and being elaborated in the leaves, it will, in its descent by the inner bark, encounter an obstruction on reaching the ringed part, for its usual course will be cut off. This causes a greater accumulation of elaborated sap above the ring than would be the case if the natural channels of

its descent were uninterrupted; hence the portion of the stem immediately above the incision is thicker than that below, the buds are more disposed to form blossom-buds, and the fruit is larger and more highly coloured. Similar results may be observed when a branch, through canker, has a portion of both inner and outer bark destroyed, and this offers quite as much interruption as if the portion had been entirely removed. We have observed a branch of an apple tree live for many years with a canker extending nearly all round, and the fruit was large, and acquired a brighter colour than that on a sound branch, until the branch thus affected became enfeebled. Although ringing may be advantageously practised in some cases, yet it should be done with caution, for it weakens the tree, and will certainly kill it, if carried to a great extent. We may assist and guide nature, but cannot violate her laws with impunity.

Root-pruning.—This operation consists in shortening, more or less, the roots of a plant. Its immediate effect is a reduction of the supply of nourishment, and, consequently, a less rapid development of shoots; and, within certain limits, the slower the growth, the greater is the disposition to form blossom-buds. We say, within certain limits; for if root-pruning is practised too severely, a general debility must result, and the plant, however predisposed by the operation to produce fruit-buds, is unable to bring fruit to maturity. It is, in many cases, advantageous to have the principal feeders of the plant near its stem, just as it is to have the principal branches near the ground. Take, for example, a tree planted against a wall and in a rich border; left to nature it would grow perpendicularly, and throw out most of its branches near the top of the wall, while its roots would extend horizontally, and the principal feeders would be found near the outer limits of the border. By pruning and training, the branches can be made to furnish the lower part of the wall; but, notwithstanding this, the roots would still travel outwards; but by root-pruning, the portion of border next the wall can be occupied with fibrous instead of thick roots; for, by cutting the latter, a number of small ones is produced. Root-pruning is also usefully practised when plants have their roots injured in transplantation. It is generally better to cut lacerated or bruised roots clean off than to allow them to remain and linger;

for the young roots, which are encouraged to push from the sound portion by the cutting back, are greatly preferable to old, unsound ones. The spongioles at the extremities of hair-like roots are so delicate, that it is almost impossible to transplant them without their tips being so far injured as to render them incapable of further extension; and, when this is the case, it is frequently better to cut back to where the fibres are substantial enough to throw out spongioles of an efficient character. In practising root-pruning, with the view of checking excessive vigour and undue fruitfulness, we must endeavour not to go to any greater extent than will be just sufficient to produce the desired effect. It is injurious to cut off at once a large branch; therefore, the removal should be effected by degrees, and so it is with a large root. Of the part intended to be removed, one-half, or rather a portion with half the total quantity of fibres, may be cut off in one year, and half in the following year. Root-pruning may be performed at various seasons; in general, the safest and best season is that which is the most proper for transplanting, say, for fruit-trees, either immediately after the leaves have fallen in autumn, or just before the sap is in active flow in spring. Mr. Beattie, however, was very successful in root-pruning pear trees in summer. The end of July is a good time for trees that have no crop on them. Mr. Fleming root-prunes the apricot, peach, and nectarine as soon as the fruit is gathered, and finds it beneficial in the rather cold and damp climate of Trentham. Mr. Rivers, an excellent authority in all matters relating to fruit-trees, formerly practised root-pruning very extensively, but is now favourable to taking up the trees every second year, in autumn, and replanting them. This biennial removal answers the purposes of root-pruning, and, in our opinion, is preferable in the case of trees not too old for being readily transplanted. It has the advantage over root-pruning as regards the spreading out of the roots. In replanting, these can all be regulated, and placed in the best possible positions. In cold soils they can be raised uniformly near the surface, although most of them may have previously been too deep, and extended nearly at full length in a horizontal position. It is not so when, by root-pruning, the perpendicular roots are merely cut at a certain depth below the surface.

CHAPTER XV.

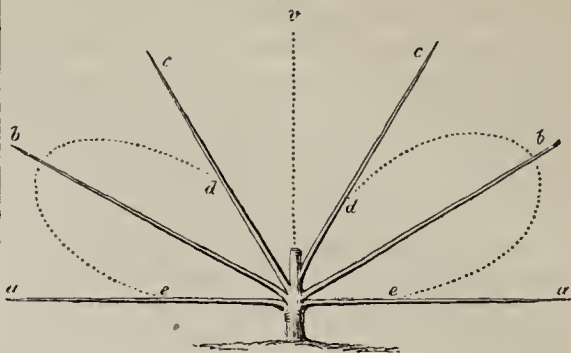
TRAINING.

Training is the conducting of the stem and branches of trees or other plants in directions different from that which they would in general naturally take. Thus, instead of an upright direction, they may be made to assume one which is oblique, horizontal, or pendulous; and, where they are naturally oblique, they may be raised to the perpendicular, or depressed to a horizontal or pendulous position. It is, in short, to give the stem and branches of plants certain artificial positions, in order to adapt them to artificial circumstances. For example, a tree planted against a wall would, if left to itself, form a huge irregular mass of branches and foliage; the number of branches has, therefore, to be regulated by pruning, and their position by training. Plants under cultivation have generally to be limited to a certain space; wall-trees, for instance, in an upright direction, at least, by the height of the wall. Fruit-trees in walled gardens cannot be allowed to take their natural growth and elevation, otherwise those on the walls, as well as the low crops, would be too much shaded. The trees must therefore be kept within certain limits; and their branches and shoots ought to be disposed to the best advantage within those limits by training. By this we can place the branches so that all of them may have a fair share of as much light as possible. This requires regularity, so that several branches may not be crowded into the space which only one should occupy. The leaves of the branches ought not to be allowed to shade one another, when, by distancing the branches properly in training, each can have the leaves fully exposed. A fair exposure to light is one of the principal objects to be borne in mind in training.

But the branches may be well regulated as regards exposure to light, without being equally so with respect to the flow of sap. For instance, they may be disposed like the radii of a circle, touching the circumference at equal distances, as at *a a*, *b b*, *c c*, and *v*, Fig. 199. We shall, however, suppose that the central vertical shoot *v* has been cut back nearly to its base, in order to furnish, from buds there situated, the rudiments of other branches; so that for the present we

have only to consider the branch on each side of the perpendicular. It has been already

Fig. 199.



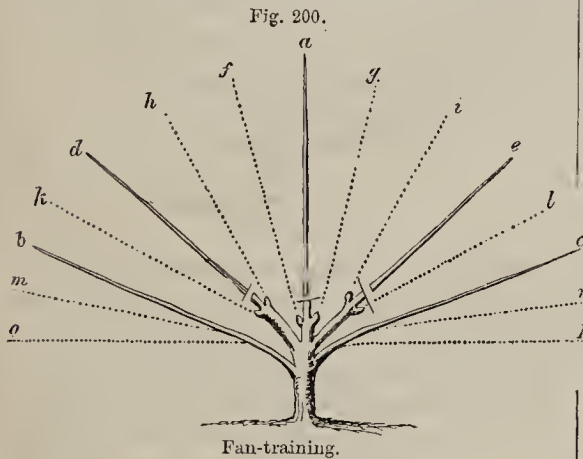
explained, that the sap flows with much greater force into the upright and nearly upright branches than it does into those having a horizontal position; therefore, branches radiating at equal distances, like those in the figure, would soon become very unequal in point of vigour; *c c* would, of course, be strong; *a a* comparatively weak; whilst *b b* would maintain a somewhat intermediate condition. If, instead of training the shoots *c c* in a straight direction, we depress them at *d d*, and bend them in the growing season, as indicated by the curved line, towards *b b*, we shall greatly check their over-luxuriance. On the other hand, by elevating the horizontal shoots at *e e*, and training them in the direction of the dotted line towards *b b*, those shoots will be thereby greatly invigorated. In short, by curving the upper branches downwards, and the lower ones upwards, the flow of sap is checked in the former and promoted in the latter; and the consequence is, that *a a* and *c c* are equal in vigour to the medium *b b*, and to each other. If we were to raise the branches *a a* so as to occupy the position of the straight-trained branches *b b*, it is evident that their growth would correspond with that which *b b* would make if they were allowed to remain; and such, also, would be the case if *c c* were brought down to the same position as *b b*. But supposing that the branches *b b* must occupy their present position, it cannot, of course, be occupied by either of the adjoining branches; yet by curving the lower and weaker ones upwards, and the upper or stronger ones downwards, the same or nearly the same effect is produced.

To regulate the branches of plants with regard to light, and to elevate or depress them in reference to the flow of sap, constitute the essential principles of training, so far as a well-

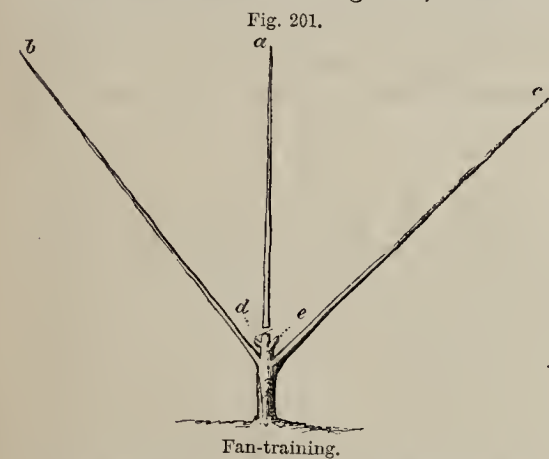
balanced vegetation is concerned. Where this is not taken into much account, as in some cases of ornamental training, the operation may be left to the guidance of fancy, assisted by mechanical ingenuity.

The principal modes of training are the *fan*, the *horizontal*, the *vertical*, the *oblique*, and the *wavy* or *curved*. All others, however designated, must be considered as modifications of these five.

Fan-training, Fig. 200, is so called from the principal branches being disposed somewhat



like the ribs of a fan. This mode of training may be commenced as in Fig. 201, where the



tree is supposed to have made its first three shoots. Of these, *b* and *c* have been trained at a considerable elevation, say about 45° , to favour their growth, and, consequently, the strength of the whole plant. At the winter pruning, *a* is cut over above three eligibly situated buds, one to form a new upright leader, the others, *d* and *e*, to give rise to two lateral branches. Turning now to Fig. 200, we find that *b* and *c* have been lowered, and that their place is occupied by the two new shoots springing from *d* and *e*, Fig. 201. But these, it will be ob-

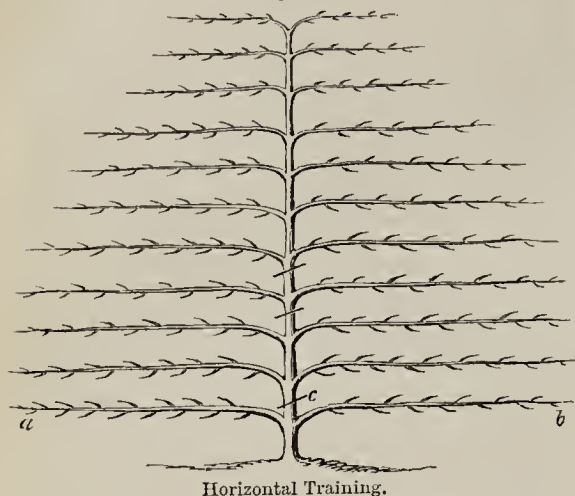
served, are shortened above buds which give rise to the branches *k*, *l*, *h*, *i*; and the leader, cut back at the same time, produces from the buds below the section two shoots, *f* and *g*; also a new upright, if necessary. The two original side-shoots, *b* and *c*, are further lowered to *m*, *n*, and finally to *o*, *p*; and as these are lowered, those above them can likewise be successively brought down. By so doing, the spaces occupied by *h*, *i*, *f*, *g* will be left vacant, but they can be filled up by again cutting back the upright shoot, as was done when *f*, *g* were produced. It is obvious that the further the branches extend the greater will be the distance between them, so that there would be room for more leading branches. When that is the case, each of the branches should be subdivided.

Fan-training, or some modification of it, is usually adopted for stone fruits, such as the peach, apricot, cherry, and plum. It is necessary, however, to observe, that when employed for these the branches should not diverge at or nearly at right angles from the central upright stem; for if so, the sap passes them, and they become weak in consequence, and prematurely die off. They ought, therefore, to be allowed to proceed from the stem according to their natural direction, and that position they should be allowed to retain near the stem. In the case of stone fruits it would, indeed, be better to originate the shoots *b*, *c* lower down the stem than they are represented in the figure, then allow them to follow at first their natural direction, and afterwards incline them by gentle means no lower than *m*, *n*. In training the peach and nectarine, the upright shoot is dispensed with, and a modification of the fan-shape is effected by branches proceeding from two main branches, such as *b*, *c*, Fig. 201.

Horizontal Training, Fig. 202, has been long employed, chiefly for the pear, on walls and espaliers. The formation of the tree is very simple. When the young plant consists of a single upright shoot or stem, it is cut down, as at *e*, above three buds, one on each side, situated at the proper height for originating the two lower horizontal branches *a*, *b*, and the third one for the upright leader. When the shoots push, the latter, of course, is trained upright, and the other two at some elevation, in order to strengthen them; for they cannot be too strong, provided they can be bent down easily when that is necessary, or towards autumn. At

the next winter pruning, the distance between the courses of horizontal branches being determined, two buds, one on each side, a little

Fig. 202.

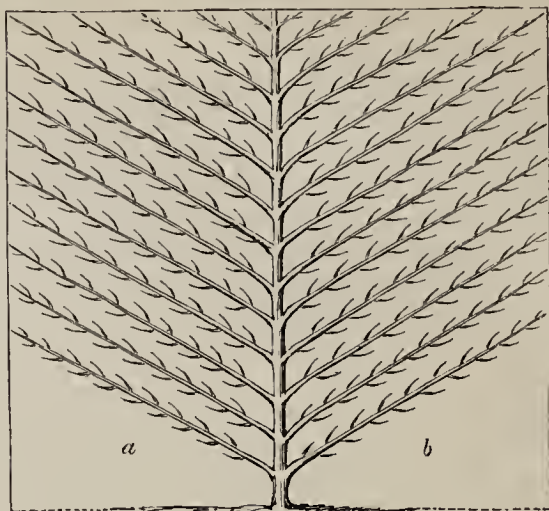


Horizontal Training.

below that distance, are to be selected, and at one bud above these the upright shoot is cut over. These three buds give rise to a second pair of horizontals and an upright shoot. By a similar mode of proceeding, all the horizontal branches are successively originated. It was stated that the buds for the lower horizontals should be selected a little below the line along which they are intended to be trained, but before reaching this, they will have an upward curve. This is recommended in order to facilitate the flow of sap into these branches. At each successive stage, the distance from the origin of the branches to the horizontal line should be less and less, and towards the top they may proceed from the stem in a perfectly horizontal line. But this only applies to apple and pear trees, and not to stone fruits; for their branches should never be trained at right angles from a perpendicular stem; they should in all cases be allowed to take an ascending direction for some distance from their origin. Instead of cutting back the central stem at each winter pruning, so as to have only one horizontal course in a year, some, favoured with a good soil and climate, will make two or more, as has been done in many instances with pear trees in the royal gardens at Frogmore. But to do this, the trees must be vigorous, and the central shoots stopped in summer, so as to throw out laterals at the proper place. Unless, however, the tree is vigorous, it is not advisable to originate branches except from mature buds, for laterals are not so substantial.

Oblique Training is represented in Fig. 203. The branches are obtained at regular distances,

Fig. 203.

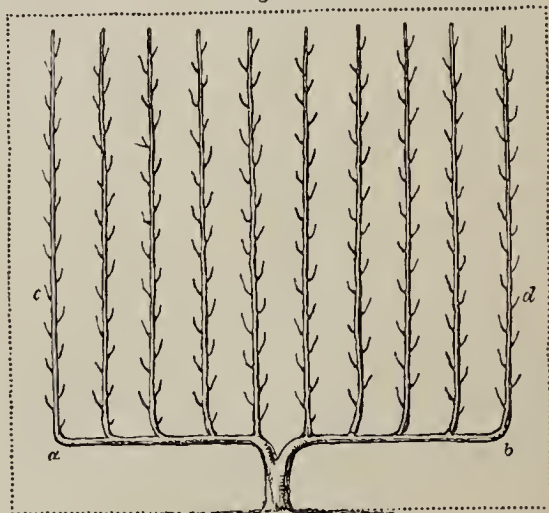


Oblique Training.

in the same way as in horizontal training, the only difference being, that instead of afterwards training them in a horizontal direction, they are made to start upwards. That direction of the branches is more favourable to their growth than the horizontal, and is consequently better adapted for weak-growing varieties. The wall is sooner completely covered, with the exception of the portions *a b*, at the lower part.

Upright Training is represented in Fig. 204. The horizontal portion *a b* should be trained obliquely at first, like an open Y, and

Fig. 204.



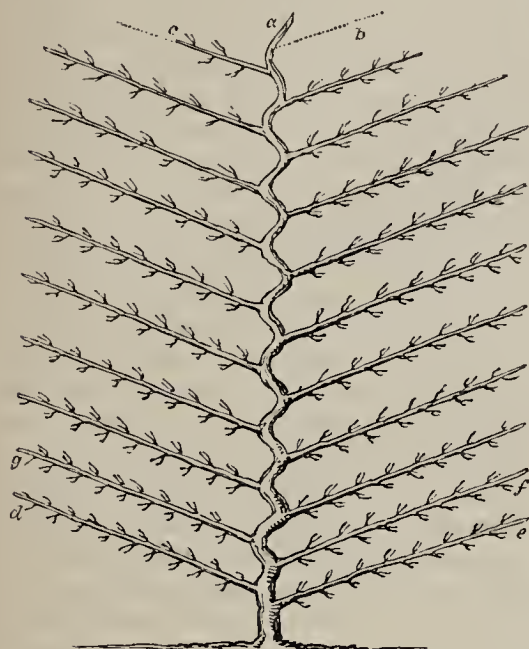
Upright Training.

lowered by degrees to the horizontal position. Shoots will push, more especially on the upper side; but they must be kept in check till the horizontal branches *a* and *b* have had their extremities advanced towards *c* and *d*, and then

the whole may be allowed to grow upwards, but at an equal pace. The greatest care must be taken to prevent any one from getting in advance of the others. If any show this disposition, it should be immediately checked.

Wavy or Curvilinear Training.—This admits of many variations. The stem may be

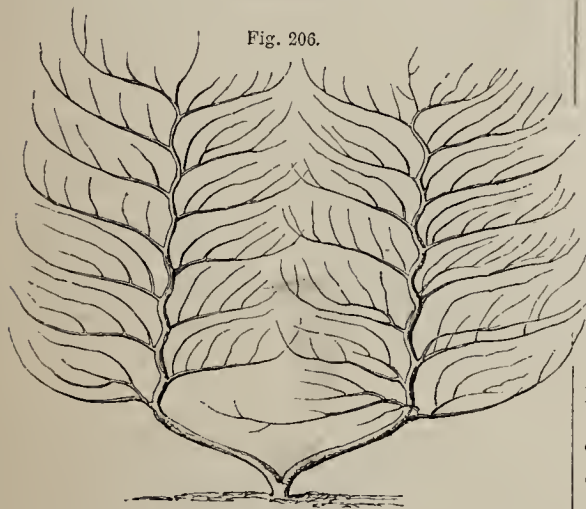
Fig. 205.



Wavy or Curvilinear Training.

serpentine and the branches oblique, Fig. 205; the stem may be straight and the branches wavy; or both stem and branches may be

Fig. 206.



Wavy or Curvilinear Training.

wavy, as in Fig. 206. The object of all these modes is to prevent the sap from flowing, according to its natural tendency, in much greater abundance towards the upper part of the tree than it does into the lower

branches. It has been well ascertained that if the main stem were straight, instead of curved, as it is in Fig. 205, and the branches diverging from it in the same direction as they are represented to do in that figure, the sap, following its direct upward tendency, would not turn readily aside to give a fair supply to the lower branches, which would consequently become weak, and the more so as those on the upper part become, on the contrary, too strong. But this is not the case when the stem is wavy, for we can depress its leader *a* towards *b*, till it has no vertical advantage over the branch *c*. The strength of the laterals, with reference to the main stem, can thus be regulated so as to bear a due proportion to each other. In starting the young tree for this mode of training, the maiden shoot of the preceding summer's growth should be cut back before winter to three good eyes, one on each side, to give rise to the branches *d*, *e*, and the other for the prolongation of the leader. The former two should be trained during the summer at an angle of about 45°. The leader ought to be inclined, say to the right, and then to the left, so as to form a bend where the next branch, *f*, is intended to be originated; and, as it grows, the same leader must be again turned from left to right, thus forming another bend from where it is intended that the branch *g* should proceed. As the bud situated at the outward or convex part of a bend is almost sure to push, several bends may be made in the same season, if the leading shoot is vigorous, but otherwise it will be a more certain course to cut back, as in horizontal training, to a bud for a leader above two others eligible for the formation of two side branches. The distance between the branches must be determined according to the kind of tree. In pears the branches may be 9 inches or 1 foot apart, in peaches 1 foot, in order that there may be room to train in bearing shoots and others from the bases of these for succession. It has been found, that where the sun's rays strike directly on the bend at about two or three o'clock P.M., the bark is apt to scorch and crack, and, to prevent this, it is advisable to train some shoots over the stem.

The stem may be straight and the branches wavy; but this, as already observed, would be no encouragement for the sap to enter the latter, but quite the contrary; therefore, on the whole, that mode cannot be recom-

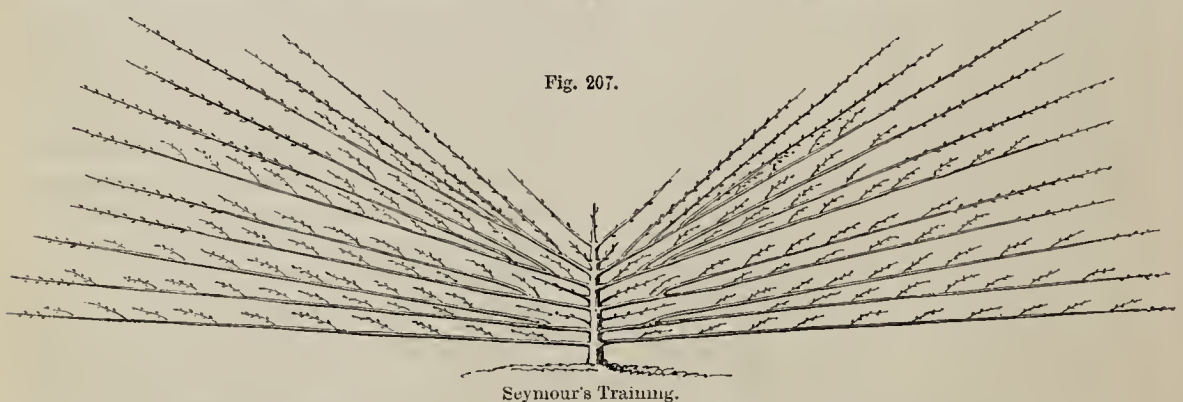
mended. In some cases it may, however, be partially adopted, as when certain branches in the upper part of a tree, and favoured by an upright position, are likely to become too luxuriant for the others.

The mode represented in Fig. 206, in which both the stem and branches are wavy, was recommended by Mr. Hayward. It succeeds with careful management, but there are serious objections to its general adoption. In the first place, two naked stems are trained in the Y fashion, each to the length of about 4 feet. This takes some years. Then the upper sides of these branches, if not protected, become scorched with the sun. Again, if a branch of a fan-trained tree should die, others can be brought down to fill up the vacancy, so that the loss is not apparent; but, by the mode in question, if one of the limbs should gum and die, the tree is left unsightly, with only one wing the position of which cannot be altered to cover the bare portion of the wall. One of the two limbs of a subdivided stem is much more liable to die than a single stem. Instead of two, it would, therefore, be far better, in wavy training, to have only a single serpentine stem, as in Fig. 205, with wavy branches, like those in Fig. 206. The latter, it will be seen from the figure, have an ascent on springing from the stem, then incline to a nearly horizontal position, and again curve upwards towards their extremities. The first direction allows the sap to enter; it is a little

checked in the nearly horizontal position, but it will there swell the buds for fruit, while the turned-up extremities will be in a favourable position for drawing sap to maintain sufficient vigour in the branch. The advantage, then, of this mode is, that all the principal branches are on an equality as regards inclination. One portion is not horizontal, or nearly so, whilst another is almost or quite vertical, as must be the case in fan-training. This equality tends to a regular distribution of the sap, and uniformity of growth throughout the tree is consequently induced. Should one of the branches, except the lowest, die, a shoot may be trained, from the base of the one next below it, to supply its place. If the lowest fail, a bud may be inserted even under the old bark in spring, or at the usual season of budding.

In Hitt's mode of training the peach, the stem is divided into two branches, which, after diverging, are carried up in a serpentine manner, as in Hayward's; but the branches are made to proceed from the bends in a horizontal direction, and from these horizontals bearing shoots are trained perpendicularly at regular distances. The trees subjected to this mode bear very well, but are liable to the same objections as those trained in Hayward's; that is, when one of the main limbs gives way, a large portion of wall is left bare, while the remaining half of the tree presents an unsightly appearance.

Seymour's Training—Fig. 207.—Among



the modifications of fan-training we must mention Seymour's; for none presents a more elegant design or greater regularity. From a point near the base of the tree, a semicircle with a radius of 10 feet is described. A nail, driven in at every 10 inches on the circumference, serves to mark the points towards which the leading shoots are directed. The number of these shoots, when the tree is com-

plete, is about forty. Bearing shoots are encouraged at every 12 inches, but only upon the upper sides of the branches, and to these they are tied down, a succession shoot being encouraged from the base of each. The whole has a very regular fan-like appearance. We have seen a tree trained in this way extending nearly 40 feet along the wall, and covering it to the height of 10 feet. But when trees so trained

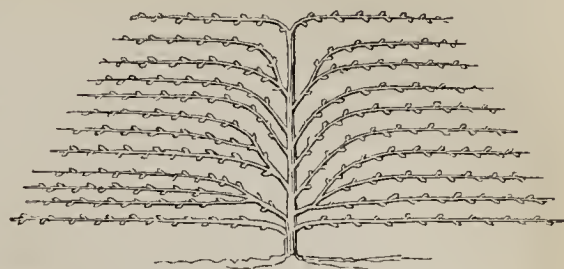
have attained nearly their perfect form and development, they commence to decline. As the upper branches, profiting by their more upright position, become strong, the lower ones, proceeding at right angles to the stem, become weak, linger, and ultimately die off. Previous to this, their junction with the stem has not a natural appearance. They have not that shouldering which branches taking their natural direction have, and a round stick, thrust into a hole made horizontally in the side of a tree with an auger, presents a nearly similar junction. The lower branch can only increase in thickness in proportion to the quantity of leaves which that branch can bear. The stem not only thickens partly by these, but also by the leaves borne by all the branches above the lower ones, and when these amount to the number of eighteen on each side, the increase of the stem will be eighteen times greater than that of the horizontal branches. The disproportion between these and the stem becomes every year more and more apparent. The sap prefers the abundant channels, and is not inclined to turn suddenly, at right angles, from that course into the contracted channels of the lower branches, and hence these branches perish one after another.

Horizontal-training with a Double Stem.—In the formation of this, the young tree is cut back to two good eyes, one on each side. If both push with equal vigour, they are trained like the forks of the letter Y, but if they do not do so, the stronger must be depressed, and the weaker elevated, till an equality is obtained, and when this is the case both should be trained at an angle of 45° . The shoots ought to be directed perpendicularly, so as to form stems about 1 foot apart. From one of these stems shoots are trained at proper distances for horizontals to the right, and from the other to the left. The only difference between this mode and common horizontal training is that, instead of the horizontal branches proceeding from each side of a single stem, they are taken from one side of two stems. This is apt to cause some inconvenience, arising from the liability of one stem to become stronger than the other. In that case, there is a loss to the general growth of the tree, for the vigorous growing side must be held in check till the one of weaker growth make up for it.

Fan and Horizontal Training combined.—This is represented in Fig. 208. It may be very conveniently adopted in the case of apple,

and more especially pear trees, which have been trained for some time against a wall that

Fig. 208.

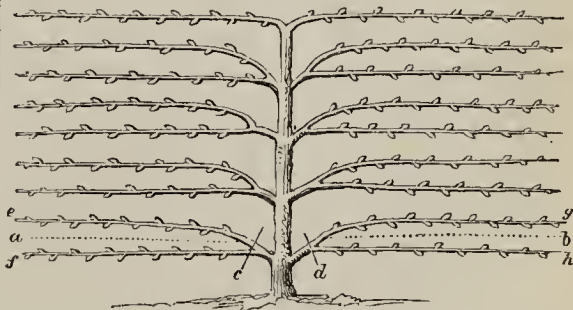


Fan and Horizontal Training combined.

is too low for such a mode being profitably continued. A certain portion of wall can also be much sooner covered in this way than by the horizontal method.

Modification of the Common Horizontal Training.—It was explained, with reference to Fig. 202, that one or more pairs of horizontal branches were annually obtained, that in some cases only one pair could be substantially originated, and that each horizontal proceeded more or less directly from the upright stem. Presuming that the horizontals are as much as 1 foot apart, and that the wall on which they are to be trained is 10 feet high, it then takes ten years, at one course a-year, to reach the top of the wall. If the wall could be covered in half the time it would certainly be most desirable; and, in order to do this, the mode represented in Fig. 209 may be adopted. It essentially differs from the common mode, in having only half the number of

Fig. 209.



Modification of Horizontal Training.

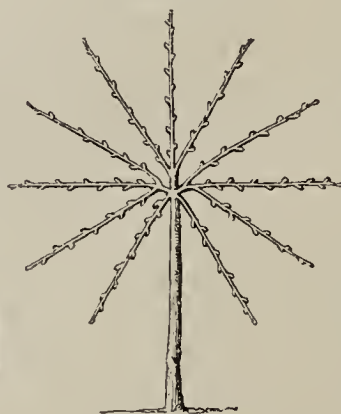
branches proceeding immediately from the stem, but at double the distance, and in these being afterwards subdivided. Thus, side shoots are encouraged at every 2 feet, and then subdivided, so as to form horizontals 1 foot apart. The following is the mode of proceeding, which, it is presumed, will be found easy enough. Let the maiden plant be cut down as for ordinary horizontal training, and let an upright

and two horizontals, represented by the dotted lines *a, b*, be trained in the following summer, throughout the greater part of which they should be allowed to take the direction *b c*, Fig. 201, but lowering them towards the end of the growing season to the position of *b c*, Fig. 200. In autumn, cut the upright about 2 feet above where it was cut in the previous year, for a new upright and two side shoots. Also cut the shoots *a, b*, Fig. 209, within about 4 inches from the stem, as at *c, d*. In the following spring, buds will push from the base part, or that which was left by the cutting back at *c* and *d*. Select two from each, and train at 1 foot apart. Thus, instead of one horizontal, as *a, b*, there will be two on each side, as *e, f, g, h*. Proceed in a similar manner with the other branches, till the whole of the horizontals are formed. From the cutting back of the upright shoot to 2 feet from where it was previously shortened, three young shoots are annually produced and trained, one as an upright, another as a horizontal to the right, and the third as a horizontal to the left. Both of the latter are cut back near the base in autumn; and from the base of each of them, two shoots are trained in the following season.

The advantages of this mode are, first, the covering of the wall in about half the time required for single horizontals; second, the united bases of the two branches *e f* must, of course, become much thicker than the base of a single horizontal, because the former derives substance from the foliage borne by two branches, the latter from that borne by one only. By the mode in question, then, it is evident that the branches are of thicker substance at their connection with the stem than would be the case by the common mode of horizontal training, and this must be an advantage, inasmuch as it gives them a better hold. The thicker the stem, and the smaller the branches that proceed from its lower part, the more liable the latter are to die off. Let us suppose a tree to have sixteen horizontal branches, or eight on each side, and each to be 1 inch in diameter. The area of the section of each would be $\cdot7854$ inch, or rather more than $\frac{3}{4}$ ths of a square inch; and the aggregate area of the sixteen branches would then be 12·5664 inches. Now it has been ascertained that the area of a section of a stem is about equal to the aggregate sectional area of all the branches above it; and that being the case,

the stem would be about 4 inches in diameter. Supposing that on each horizontal branch a layer of $\frac{1}{10}$ th of an inch thick of alburnum is deposited, their diameter would consequently be increased $\frac{2}{10}$ ths. The sectional area of each would be 1·1309, and the aggregate increase 5·5292, or rather more than $5\frac{1}{2}$ inches. The area of the stem section, increasing in proportion to that of the branches, would then be rather more than 18 inches. But this area requires a diameter of $4\frac{8}{10}$ inches. Hence, it appears that whilst each of the sixteen branches increases $\frac{2}{10}$ ths of an inch in diameter, the stem below them increases $\frac{8}{10}$ ths, or four times as much. When two horizontals spring from one base, as in Fig. 209, the sectional area of that base, being equal to that of both the horizontals, is 1·57 inch, and its diameter 1·414 inch. Increasing in the same ratio as the branches, its area at the end of the season would be 2·2618 inches, and its diameter 1·696 inch, being an increase in diameter of nearly $\frac{2}{10}$ ths of an inch, or nearly one-third more than when the branches spring directly from the stem, as in common horizontal training. The proportion which the diameter and the circumference of the base, subdividing into the branches *e, f*, Fig. 209, bear to the diameter and circumference of the stem, is as 17 to 48; but supposing all other circumstances to be the same, the horizontals to be of equal strength, and each directly attached to the stem, the proportion would only be as 12 to 48. The mode represented in Fig. 209 may therefore be adopted, not only on account of its covering the wall more speedily, but also in order to give the branches a stronger connection with the stem. It may be observed,

Fig 210.



Stellate Fan-training.

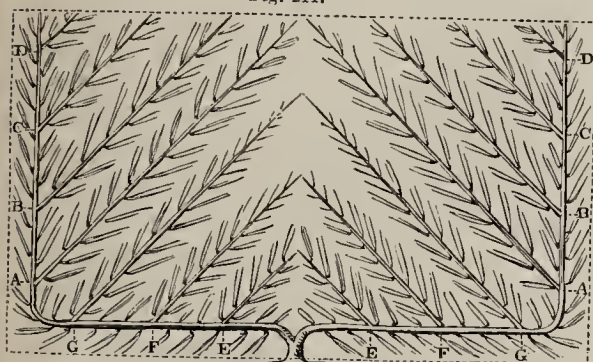
Stellate Fan-training—Fig. 210.—This was formerly much employed for temporary stan-

that Mr. Smith, of Hopetoun House, invented a mode of training very similar to the above, but differing from it in the stem being divided into two upright branches, from which the horizontals were originated in precisely the same manner.

dards, intended to cover the upper part of a wall until such time as the permanent trees required the space. It is merely training the principal branches so as to radiate in all directions. Care must be taken to prevent, as much as possible, the upper part from growing too strong.

Chandelier-training, with the branches oblique, is represented by Fig. 211. Two main

Fig. 211.



Chandelier-training, with Branches Oblique.

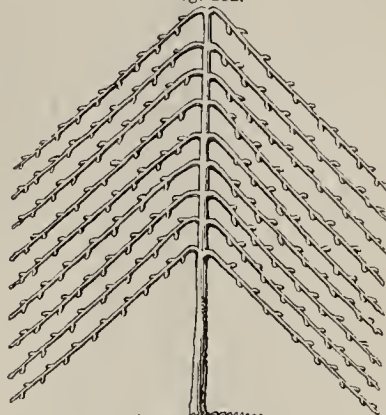
branches are trained horizontally, nearly as far as the tree is intended to extend, and their extremities are then turned up perpendicularly. As these proceed, secondary branches, A, B, C, D, are trained obliquely inwards, at an angle of 45°. When these have extended as far as their assigned limits, the branches E, F, G are allowed to grow, and are inclined at the same angle as the others; consequently, each secondary branch is parallel to all the others on the same side. From this uniform inclination of the branches, an equal distribution of the sap must result. It is true that the branches E, F, G are reversed; but were this not the case, or were they allowed a more erect position, they would appropriate too much of the sap, and become too strong for the others. The sap will not flow so readily into G as it will into A, for instance, because the latter diverges at a more natural angle; but if G, and likewise E, F, be allowed to grow erect for 2 or 3 inches, and are then inclined parallel to A, the flow of sap will be equalized.

Oblique Single-stem Training.—This mode is sometimes employed in order to cover a wall more promptly than it could be by any other means. It consists in planting maiden plants of peaches, or other kinds of fruit-trees, at 2½ or 3 feet apart, and then training the stems at an angle of 45°, bearing wood being encouraged in the intervals.

Pendulous Training, Fig. 212, has been recommended, and occasionally practised, in the

case of apple and pear trees against walls, especially when the variety, either naturally or owing to other circumstances, is more apt to grow to wood than to produce fruit. This mode has certainly the effect of inducing fruitfulness, and trees by means of it can be kept in small space. But great care must be taken

Fig. 212.



Pendulous Training.

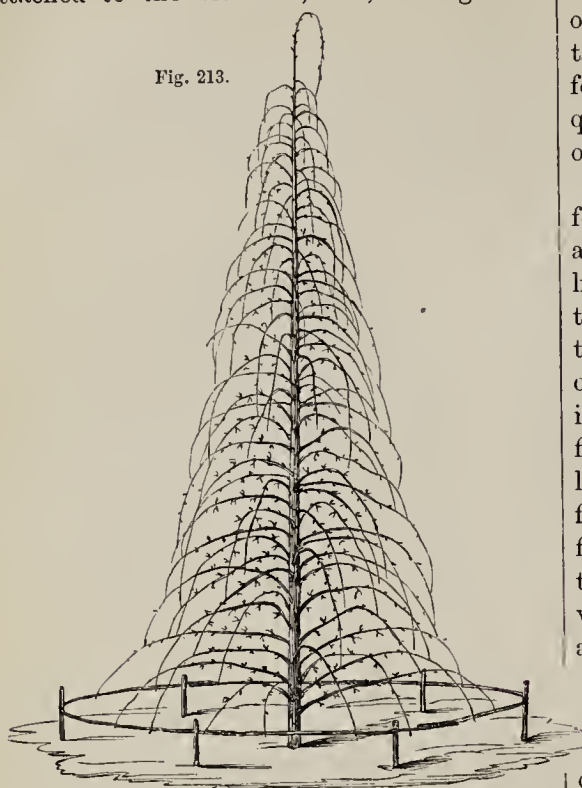
in summer to check all shoots taking an upward direction, otherwise the pendulous branches will be robbed, and will ultimately become too weak, which they are also apt to do if allowed to bear too much fruit.

Pyramid-training.—There are several kinds of this, but they all present the same general appearance—that of an upright stem furnished from the top to within 15 inches of the ground with branches, of which those next the ground are longest, the next above these somewhat shorter, the next higher shorter again than those immediately below them, and so on to the top; the whole presenting the form of a pyramid or cone. This may be of greater or less height; but the form in which the height is equal to the circumference at the base is considered the most handsome.

Pyramid with the branches bent downwards.—In rich, damp soils, the apple and pear, when trained in the form above described, are apt to throw out shoots instead of forming fruit-spurs. When this is the case, it is a good plan to leave the shoots at length, and train them downwards, as represented in Fig. 213. The branches are allowed to grow without shortening until the lower extend fully beyond the space which the tree is intended to occupy. A hoop is then placed on the ground, to mark a circle of which the tree is the centre. Small stakes are driven in the line marked by the hoop, and so as to stand about 10 or 12 inches above the ground, and to the tops of

these the hoop is secured. Strings are then attached to the branches, and, having been

Fig. 213.



Pyramid with Pendulous Branches.

pulled so as to arch them downwards, are tied to the hoop. The lower branches being thus secured, the next tier is tied down to them, and so on. In proceeding, however, towards the top, the curves should extend less and less from the tree, so as to preserve the conical or pyramidal outline. No branch will then be completely overhung by any one of higher origin on the stem.

Chandelier Pyramidal Training (Pyramide Girandole of the French) is represented in Fig. 214. Instead of the branches being encouraged at uniform distances along the

Fig. 214.



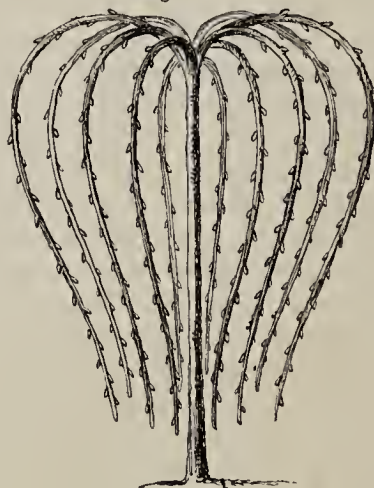
Chandelier Pyramidal Training.

stem, as in the common pyramid, they are in this form placed in stages, with about 18 inches of clear stem between each. It has the advantage of allowing a freer access of light to the foliage and fruit near the stem, and, consequently, favours the colouring and ripening of the fruit.

Besides the above modes, pyramids are also formed by stages at the uniform distance of about 15 inches, with the branches trained horizontally. Again, the branches forming the different stages are, by some, so trained that the branches of one stage are not directly over those of the one beneath it, but over the intervals between them. Others, again, make five branches radiate from the stem for the lower tier, then other five exactly over the first five, and so on; thus forming, as it were, five angular recesses, separated by five partitions of branches. Some trees trained in this way at the Jardin des Plantes, at Paris, have an elegant appearance.

Balloon-training, Fig. 215, answers tolerably well for pear and apple trees, provided the top is kept perfectly clear, in summer, of upright shoots, which are so apt to spring up. These should be rubbed off immediately they make their appearance. In forming the

Fig. 215.



Balloon-training.

the curve representing the top of the balloon, they should be tied down to a hoop, which is secured by small stakes driven somewhat obliquely into the ground.

Vase with dwarf stem and upright branches, Fig. 216.—To form this, the maiden plant is cut about 1 foot from the ground. Three shoots may be encouraged, and trained at an angle of about 45°. In the succeeding autumn these should be cut to within 3 or 4 inches of

their origin, and in the following season two shoots can be trained from each, at the same angle as were the shoots of the previous year, till near the end of the growing season, when

Fig. 216.



Vase with Dwarf Stem.

they may be brought nearer to the horizontal. By again shortening the shoots, the number

for training in the ensuing season will be doubled. Although three shoots could be obtained from each one that is shortened, yet two is a preferable number, because one of the three is apt to grow too strong for the others, but two can be more easily kept on an equality. When the shoots have grown to the intended width of the vase, their points should be turned up perpendicularly at regular distances, and trained to hoops; and from the uprights bearing branches should be trained obliquely.

Fig. 217.

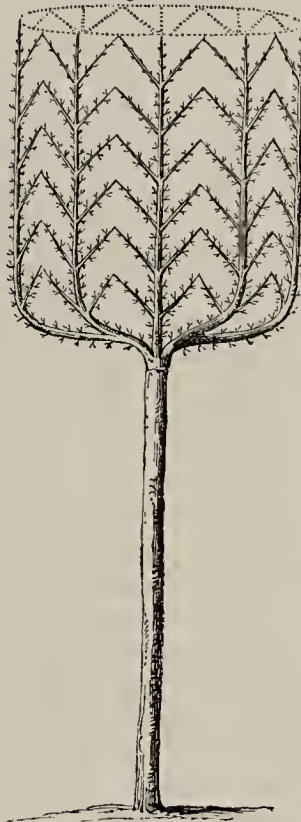


Vase Pyramid.

Vase Pyramid, Fig. 217.—When the vase

is completely formed, as in the preceding case, a shoot is, in this form, allowed to grow upright from the centre, and is trained with a single stem till it is about 20 inches above

Fig. 218.



Vase with Tall Stem.

the top of the vase. It is then managed so as to form a small pyramid from $2\frac{1}{2}$ to 3 feet high, according as the upright branches forming the vase are more or less vigorous. According to M. Du Breuil, this pyramid affords an outlet for the super-abundance of sap in the uprights of the vase; but if these should get weak from bearing, the growth of the pyramid should be kept in check.

Vase with a tall stem, Fig. 218.—The only difference between this and the dwarf vase is

the taller stem. There is a number of fruit-trees trained in this form in the gardens of the Luxembourg at Paris, and with very good effect. They require to be carefully attended to as regards summer pruning and training; but, if well managed in these respects, they bear very well, and are preferable to common, rambling-headed standards near walks in walled-in gardens.

CHAPTER XVI.

THE APPLE, PEAR, QUINCE, AND MEDLAR.

THE APPLE (*Pyrus Malus*, L.; *Malus communis*, D. C.) — Icosandria Pentagynia, L.; Rosaceæ, J.; Pomaceæ, Lind.), termed in its wild state the *crab*, is indigenous to Britain, and to most warm and temperate parts of Europe. It proves only half-hardy at St. Petersburg, but resists the cold which occurs in the extreme north of the British Isles, and

some of its cultivated varieties can be there fruited in tolerable perfection.

The tree forms, in general, a round spreading head, and does not aspire to the height of the pear, yet, under equal circumstances, it acquires a thicker stem. Where the soil is good, and the subsoil not retentive nor liable to become at any time too dry, it will live for hundreds of years. It will succeed in climates too cold for the pear, plum, and cherry; it also blossoms later than any of these—in May, generally a warm period of the season—and thus escapes the frosts which often ruin the crops of the above-mentioned fruit-trees, which blossom in April, or earlier. The blossoms of the apple are, however, equally as tender as those of the earlier flowering sorts of fruit-trees, or even more so, if subjected to an equal degree of frost.

No other kind of fruit-tree is so well adapted for cultivation in the gardens of all classes, and none affords so lasting and so generally useful a supply. The fruit of some of its early varieties is fit for use in July, and that of some later ripening sorts may be kept till that time in the following season, and even later. Its usefulness for the dessert, for numerous culinary preparations, in confectionary, and for the production of cider, is so well known as only to need allusion here.

The varieties of the apple are exceedingly numerous, and we may safely state that thousands of them exist nameless, and only known as seedlings in the locality where they originated. There are hundreds of such in this country; and in America, according to all accounts, the number is much greater. Some varieties are cultivated for their rich flavour, others for their peculiar fitness for culinary purposes, and for the confectioner; some for their size and beauty, others for their late keeping, hardness, and abundant bearing; and, finally, a numerous class is extensively cultivated for their peculiar adaptation for the manufacture of cider. When we further consider that, with regard to dessert apples, tastes vary greatly—some persons preferring brisk, and others sweet-flavoured apples—that a considerable number of sorts is required for a full succession throughout the year, and that different soils and climates require different varieties, it is evident that the number of sorts necessary to be retained in cultivation must be considerable.

The varieties of which the following descrip-

tions are given are all of great merit, and form a collection of good sorts for the dessert and for kitchen use.

I.—DESSERT APPLES.

1. ADAMS' PEARMAN—syn. Norfolk Pippin.—*Shoots* long, rather slender, of a dark chestnut colour, thinly sprinkled with small pale dots, slightly downy. *Leaves* middle-sized, ovate, concave, acuminate, doubly and sharply serrated. *Petioles* about 1 inch in length, rather slender. *Fruit* rather above the medium size, pearmain-shaped, with a regular outline, broadest towards the base, without angles. *Eye* rather large, open, deeply sunk in a narrow, slightly plaited basin. *Stalk* generally long and slender, inclining to one side, and inserted in a shallow cavity. *Skin* greenish yellow, thinly covered with spots of soft, brown russet on the shaded side; next the sun red, intermixed with yellow, lightly streaked with darker red, and thinly sprinkled with whitish spots, which are most numerous near the base. *Flesh* yellowish white, firm, crisp, rich, sugary, juicy, with an agreeable, brisk acidity and high flavour.

A handsome and sound-keeping dessert apple; in season from November to February.

The tree is very hardy, healthy, and a good bearer.

2. AUTUMN PEARMAN—syn. American Pearmain, Royal Pearmain of many, Summer Pearmain of some.—*Shoots* moderately strong, of a brownish violet colour, thinly strewn with gray specks, moderately downy. *Leaves* middle-sized, ovate, somewhat acuminate, rather sharply serrated. *Petioles* of medium length, slender. *Fruit* large, pearmain-shaped, tapering gently towards the apex, without angles on the sides. *Eye* open, set in a broad, shallow, slightly plaited basin, sometimes almost level with the top. *Stalk* short, obliquely inserted, having on one side a fleshy projection of the base of the fruit. *Skin* smooth, brownish yellow on the shaded side, yellow marbled with red and streaked with brighter red next the sun, frequently covered with russet at the base, and sprinkled with numerous specks of brown russet. *Flesh* yellow, firm, crisp, not very juicy, but sweet, rich, and highly aromatic.

A very handsome and excellent apple for the dessert, and one which is also suitable for kitchen purposes. It is in season during Sep-

tember, and the first fortnight of October, after which period it generally becomes mealy.

The tree attains a large size, is of an upright habit, vigorous, and a good bearer.

3. BARCELONA PEARMAIN—syn. Speckled Goldeu Reinette, Reinette Rousse, Reinette des Carmes, Glace Rouge, Kleine Casseler Reinette.—*Shoots* long, moderately strong, of a dull chestnut colour, thinly sprinkled with pale brown dots, very downy. *Leaves* rather small, oval, terminating abruptly in a long tapering point, rather sharply serrated. Petioles rather long and slender. *Flowers* rather small. Petals oval, inclining to ovate, not imbricated when fully expanded. *Fruit* middle-sized, oval, without angles. Eye small, open, set in a rather shallow, slightly plaited basin. Stalk short, slender, inserted in a small, shallow cavity, and having generally a small fleshy protuberance from the base of the fruit attached to one side. Skin pale brownish yellow where shaded, rich bright red next the sun, and marked with numerous triangular russet scars, which are brownish on the shaded side, yellowish on that exposed to the sun; the whole presenting a speckled appearance. Flesh yellowish, firm, and rich, with an agreeably sub-acid juice, and an aromatic flavour.

A very good, and, when well coloured, a beautiful dessert apple; in season from November till February.

The tree is vigorous, of rather dwarf habit, and an excellent bearer, either as a dwarf or standard.

4. BAXTER'S PEARMAIN.—*Shoots* strong, brown, very downy towards the extremities, sprinkled near the base with distinct gray dots. *Leaves* large, roundish oval, somewhat acuminate, coarsely and sharply serrated. Petioles of medium length. *Fruit* rather large, roundish pearmain-shaped. Eye rather large, open, set in a shallow depression, surrounded with some obtuse folds. Stalk short, thick, placed in a wide, rather shallow cavity. Skin light green, tinged and obscurely streaked with red next the sun. Flesh yellowish, firm, moderately juicy, with a brisk rich flavour.

An excellent kitchen apple, and very good for the dessert; in season from November to March.

The tree is of large growth, very hardy and productive, bearing well even in unfavourable seasons.

5. BEACHAMWELL—syn. Motteux's Seedling.—*Shoots* moderately strong, bright chest-

nut, sprinkled with small whitish spots, slightly downy. *Leaves* middle-sized, ovate, acuminate, obtusely creuated. Petioles rather short. *Flowers* middle-sized. Petals oval, not imbricated when fully expanded. Fruit small, ovate, with a regular outline, somewhat flattened at the base and apex. Eye small, open, set in a shallow, evenly rounded hollow. Stalk short, moderately thick, set in a small, round cavity. Skin greenish yellow, sprinkled with some brown spots. Flesh yellowish, tender, juicy, brisk, and rich.

An excellent dessert apple; in season from December till March or April.

The tree is of medium growth, very hardy, and a good bearer. It should find a place in every collection.

6. BLenheim PIPPIN—syn. Blenheim, Blenheim Orange, Northwick Pippin, Woodstock Pippin.—*Shoots* strong, spreading, purplish brown, sprinkled with a few large gray dots, covered with a silvery epidermis, slightly downy, the lower portion nearly smooth. *Leaves* large, roundish cordate at the base, acuminate, rather sharply but not deeply serrated. Petioles very short. *Fruit* very large, globular, somewhat depressed, rather broader at the base than at the top. Eye large, open, set in a wide, shallow, even depression. Stalk short, thick, inserted in a cavity of medium size. Skin greenish yellow at first, deep yellow when fully ripe, streaked with dull orange red next the sun. Flesh yellow, crisp, juicy, sweet, and rich.

A beautiful and regularly formed apple, of excellent quality either for kitchen or table use; in season from November to February.

The tree is vigorous, and in good soil grows rapidly to a large size. Whilst young it bears rather thinly, but after it has formed a considerable quantity of wood, it commences to bear in larger quantity, and ultimately very abundantly.

It was raised near Blenheim Park, at Woodstock, in Oxfordshire, where the original tree till lately existed.

7. BOSTON RUSSET—syn. Putman's Russet, Roxburgh Russet, Shippen's Russet of some.—*Shoots* strong, of a bright chestnut colour, covered with a silvery epidermis, thinly sprinkled with whitish dots, moderately downy. *Leaves* middle-sized, roundish oblong, acuminate, regularly serrated. Petioles of medium length. *Fruit* middle-sized, roundish, sometimes obtusely conical, broadest near the base,

flattened at both ends, obtusely angular on the sides. Eye rather large, closed, set in a wide, moderately deep cavity. Stalk short, of medium thickness, sometimes long and slender, inserted in a moderately deep hollow. Skin yellowish green, intermixed throughout with brownish russet, and faintly tinged with reddish brown next the sun. Flesh yellowish, crisp, sugary, and rich, with a brisk juice, partaking of the flavours of the Ribston Pippin and Old Nonpareil.

A most excellent dessert apple; in use from January to April.

The tree is not a strong grower, but very hardy, and a great bearer; the fruit proving good even in the most unfavourable seasons.

8. BRADDICK'S NONPAREIL—syn. Ditton Nonpareil.—*Shoots* moderately vigorous, of a chestnut colour, thinly strewn with whitish spots, covered with a fine down. *Leaves* middle-sized, ovate, tapering to the point, doubly and deeply serrated. Petioles long and rather slender. *Fruit* middle-sized, depressed globular, tapering a little towards the apex. Eye rather small, set in a deep even cavity. Stalk short, not deeply inserted. Skin smooth, greenish yellow on the shaded side, brownish red next the sun, generally covered with russet round the eye, and frequently russeted slightly elsewhere. Flesh yellowish, sugary, juicy, and rich, with a somewhat aromatic flavour.

A very excellent and sound-keeping dessert apple; in season from December or January to April.

The tree is not a strong grower, in consequence of its being a most abundant bearer, and apt to overbear, which, if circumstances will permit, should be prevented.

This variety was raised by John Braddick, Esq., of Thames-Ditton, who brought it under the notice of the Horticultural Society in 1818.

9. BRICKLEY SEEDLING.—*Shoots* rather slender, like those of the Nonpareil, of a brownish chestnut colour, thinly sprinkled with small gray dots, moderately downy. *Leaves* small, elliptical, acuminate, sharply serrated. Petioles rather long and slender. *Fruit* small, roundish, tapering a little towards the apex. Eye small, open, inserted in an evenly rounded, rather shallow depression. Stalk short, placed in a wide shallow cavity. Skin greenish yellow on the shaded side, of a rich, deep, brownish red next the sun, with broken streaks of red towards the junction of the two colours.

Flesh yellowish, firm, with a brisk, rich flavour.

A dessert apple, valuable on account of its sound keeping; in season from January to April.

The tree is of moderate growth, hardy, and an abundant bearer.

10. CAMBUSNETHAN PIPPIN—syn. Watch Apple, Winter Red Streak.—*Shoots* strong, of a dark chestnut brown, sprinkled with a few small pale dots, slightly downy. *Leaves* large, roundish oval, somewhat acuminate, glossy above, crenated. Petioles short. *Fruit* rather above the middle size, oblate. Eye very large, set in a wide, even cavity. Stalk moderately thick, not deeply inserted. Skin pale green, tinged with a blush of red next the sun. Flesh white, tolerably rich and juicy.

A good dessert and kitchen apple; in season from October till January.

The tree is vigorous, hardy, a good bearer, and suited for northern climates.

11. CLAYGATE PEARMAIN.—*Shoots* spreading, of a dark chestnut colour, covered with a silvery epidermis, which is somewhat reticulated near the base, thinly sprinkled with gray dots, moderately downy. *Leaves* middle-sized, oval, acuminate, sharply serrated. Petioles long and slender. *Flowers* large. Petals oblong-ovate, cordate at the base. *Fruit* middle-sized, pear-main-shaped. Skin dull yellow, slightly russeted on the shaded side, streaked with dark red next the sun. Eye large, open, rather deep. Stalk of medium length and thickness, placed in a shallow cavity. Flesh yellowish, crisp, brisk, juicy, sugary, and rich, with a high flavour, somewhat resembling that of the Ribston Pippin.

A dessert apple of great excellence, in season from November till March; but, if not preserved from air and light by stowing in casks or drawers, it is apt to lose its briskness towards the latter period.

The tree is of medium growth, hardy, healthy, and an abundant bearer.

The variety was discovered in a hedge-row at Claygate, near Thames-Ditton, by John Braddick, Esq., who first made it known to the Horticultural Society in 1822.

12. COCKLE PIPPIN—syn. Brown Cockle Pippin, Nutmeg Pippin, Nutmeg Cockle Pippin, White Cockle Pippin.—*Shoots* long, rather slender, chestnut-coloured, greenish brown near the base, sprinkled with small whitish dots, slightly downy. *Leaves* middle-sized, oval, inclining to ovate, acuminate, sharply serrated.

Petioles of medium length, rather slender. *Fruit* middle-sized, ovate. Eye small, closed, not deeply sunk, surrounded by small plaits. Stalk short, rather slender. Skin greenish-yellow, sometimes smooth, but generally covered or freckled—especially near the base and next the sun—with light brown russet. Flesh yellowish-white, firm, crisp, juicy, rich, and sugary.

An excellent, sound-keeping dessert apple; in season from January till April or May.

The tree is healthy and an abundant bearer, well deserving cultivation as a late dessert apple. It is extensively grown in Sussex.

13. COE'S GOLDEN DROP.—*Shoots* slender, chestnut-coloured where well exposed, elsewhere of a light olive brown, sprinkled with small dots, slightly downy. *Leaves* small, ovate, acuminate, irregularly and rather sharply serrated. Petioles about 1 inch in length, slender. *Fruit* small, ovate or conical. Eye small, nearly close, level with the surface, and surrounded by small plaits. Skin smooth, yellow on the shaded side, tinged with red, and generally marked with ferruginous specks on the side next the sun. Flesh yellowish, firm, and rich, with a brisk, vinous juice.

An excellent dessert apple; in season from January till May.

The tree is not a strong grower, but is a good bearer, and deserving of cultivation on account of the richness of its fruit.

14. CORNISH AROMATIC.—*Shoots* long, of moderate strength, chestnut brown, thickly strewn with distinct grayish dots, slightly downy at the extremities. *Leaves* middle-sized, ovate, somewhat acuminate, crenated. Petioles of medium length. *Flowers* middle-sized. Petals roundish oval, imbricated. *Fruit* rather large, roundish, somewhat angular, the angles more prominent towards the eye, which is small, closed, and rather deeply sunk. Stalk generally rather long, and deeply inserted. Skin on the shaded side yellow, spotted with brown, russeted with light brown at the base, of a rich russet red next the sun. Flesh yellowish, firm, juicy, rich, and aromatic.

A good table apple; in season from October to January.

The tree is of moderate vigour, and a tolerably good bearer.

15. CORNISH GILLIFLOWER—syn. Cornish July-flower, Pomme Regelans.—*Shoots* rather slender and straggling, of a dark chestnut colour, thinly strewn with small, pale, gray

dots, moderately downy. *Leaves* small, narrow, oval, acuminate, sharply serrated. Petioles slender. *Flowers* middle-sized. Petals oval. *Fruit* middle-sized or rather large, ovate, angular on the sides, the angles terminating in unequal knobby protuberances round the eye, which is deep and closed. Stalk generally rather short, slender, not deeply inserted. Skin dull yellowish green on the shaded side, brownish red intermixed with russet, and streaked with red next the sun. Flesh yellowish, firm, exceedingly rich, sugary, and delicious.

This is by many esteemed the best of all the dessert apples for flavour, but it is by no means handsome in appearance. It is in use from the beginning of December till May.

The tree is of medium size, but a shy bearer. The fruit-buds are principally produced at the extremities of the shoots, and this circumstance should be borne in mind in pruning, otherwise a great portion of the crop may be destroyed.

The variety was discovered by a gentleman, about the beginning of the century, in a cottage garden near Truro, and was brought under the notice of the Horticultural Society of London by Sir Christopher Hawkins, in 1813.

16. COURT OF WICK—syn. Court of Wick Pippin, Court de Wick, Fry's Pippin, Golden Drop, Knightwick Pippin, Phillips' Reinette, Rival Golden Pippin, Weeks' Pippin, Wood's Huntingdon, Wood's New Transparent, Yellow.—*Shoots* long and moderately vigorous, of a dark chestnut colour, marked with numerous whitish dots, slightly downy. *Leaves* of medium size, roundish oblong or ovate, acuminate, acutely crenated. Petioles of medium length. *Fruit* rather small, roundish oblate, of a very handsome, regular form. Eye large, open, set in a shallow, evenly rounded cavity, upon the sides of which the segments of the calyx recline. Stalk short, rather slender, deeply inserted in a wide, shallow cavity, the sides of which are even, and generally russety. Skin yellow on the shaded side, orange yellow, spotted with brownish russet, and sometimes faintly streaked with red next the sun. Flesh deep yellow when fully ripe, crisp, juicy, rich, brisk, and delicious.

A handsome and very excellent dessert apple; in season from October to March.

The tree is of medium growth, very hardy, and an abundant bearer, even in the most exposed situations. It ought to be cultivated in every garden.

The variety is said to have been raised from a seed of the Golden Pippin, at Court de Wiek, in Somersetshire.

17. COURT-PENDÛ PLAT—syn. Court-pendû, Court-pendû Extra, Court-pendû Musqué, Court-pendû Plat Rougeâtre, Court-pendû Rouge Musqué, Court-pendû Rond Gros, Court-pendû Rond Très Gros, Court-pendû Rond Rougeâtre, Court-pendû Rose, Court-pendû Rosat, Rode Korpendu, Rosenfarbiger Kurzstiel, Rothe Kurzstiel, Corianda Rose, Garnon's Apple, Pomme de Berlin, Princesse Noble Zoete, Russian, Wollaton Pippin.—*Shoots* short, reddish brown, moderately downy, thickly covered with down at the extremities. *Leaves* middle-sized, ovate, somewhat acuminate, their edges turned up and having small serratures. *Petioles* of medium length. *Flowers* rather small. *Petals* ovate. *Fruit* middle-sized, oblate, the transverse section somewhat resembling the figure 8 placed in a horizontal position. *Eye* large, open, set in a wide, evenly-formed basin. *Stalk* very short, deeply inserted in a wide cavity, rarely projecting beyond the base of the fruit. *Skin* yellowish green, streaked with deep brownish red on the shaded side, deep red marked with russet spots next the sun. *Flesh* yellowish white, firm, very juicy, brisk, rich, sugary, and delicious.

One of the best late-keeping dessert apples; in season from December till April.

The tree is of dwarf habit, very hardy, and an abundant bearer. The blossoms and leaves appearing at a much later period than in any other variety, the crop frequently escapes injury from late spring frosts, when the blossoms of other sorts are destroyed; hence, in some localities, it is called the Wise Apple. It succeeds well as a dwarf, especially when grafted on the Paradise stock, and may even be kept under 3 feet high with but little pruning. It is also very eligible for cultivation in pots. It requires, however, a good climate and full exposure to the sun, otherwise the fruit does not attain full perfection as regards colour and flavour.

18. DEVONSHIRE QUARRENDEN—syn. Red Quarrenden, Saek Apple.—*Shoots* moderately long, dark violet brown, thinly sprinkled with roundish and oblong whitish specks, very downy. *Leaves* middle-sized, oblong-ovate, somewhat acuminate, irregularly serrated. *Petioles* rather long, moderately thick. *Flowers* middle-sized, early. *Petals* roundish. *Fruit*

middle-sized for a dessert apple, oblate or depressed globular, from $2\frac{1}{4}$ to $2\frac{1}{2}$ inches in diameter transversely, and about $1\frac{1}{2}$ inch from the base to the apex. *Eye* rather large, but completely closed, level with the top, or slightly depressed, surrounded by shallow ridges or knobs. *Stalk* rather short and thick, not deeply inserted. *Skin* polished, of a uniform rich dark red, pale green where shaded. *Flesh* greenish white, tender, crisp, and sweet, with an abundance of brisk, very agreeable, vinous juice.

A beautiful and excellent early dessert apple; ripe in August, and keeping till about the end of September.

The tree is of medium size, very hardy, and an abundant bearer either as a dwarf or as an orchard standard.

19. DUTCH MIGNONNE—syn. Christ's Golden Reinette, Copmanthorpe Crab, Grosser Casseler Reinette, Paternoster Apfel, Pomme de Laak, Stettin Pippin, Reinette Dorée of the Germans.—*Shoots* strong, erect, bright chestnut, thickly set with whitish spots. *Leaves* large, ovate, acuminate, regularly serrated. *Petioles* long, much stained with red. *Flowers* rather large. *Petals* ovate, much imbricated at their base, pale blush. *Fruit* middle-sized, roundish, somewhat oblate, rather broader at the base than at the apex. *Eye* very small, generally closed, deeply inserted in a narrow basin, the sides of which are sometimes slightly plaited. *Stalk* 1 inch in length, deeply inserted. *Skin* greenish yellow, mottled with dull red, and marked with broken streaks of red and crimson next the sun, sprinkled all over with numerous white, green, and russet dots. *Flesh* greenish yellow, firm, crisp, and rich, with an abundance of brisk, sub-acid juice.

An excellent apple either for the table or for culinary purposes, keeping well, and retaining its flavour from December till April.

The tree is vigorous, of large growth, very hardy, and a great bearer; but to attain perfection for table use, the fruit requires a good season.

20. EARLY HARVEST—syn. Yellow Harvest, Large Yellow Harvest, Prince's Yellow Harvest, Prince's Harvest, July Pippin, July Early Pippin, Large Early, Large White Juneating, Prince's Early Lemon, Tart Bough, Early French Reinette of the Americans, Pomme d'Été of Canada.—*Shoots* slender, chestnut brown, partially covered with a

grayish epidermis, and sprinkled with a few small, pale, yellowish brown spots, slightly downy. *Leaves* small, roundish or roundish oval, shortly acuminate, finely serrated. Petioles of medium length. *Fruit* middle-sized, roundish, somewhat flattened at both ends. Eye small, closed, placed in a shallow basin. Stalk short, rather slender, inserted in a wide, rather shallow cavity. Skin pale greenish yellow when the fruit is first gathered, turning to pale yellow when it is best for eating, marked near the eye with numerous whitish dots appearing as if below the skin. Flesh white, crisp, tender, sweet, and rich, with a brisk, highly refreshing juice, and a flavour closely resembling that of a well-ripened Newton Pippin.

Hardly surpassed as a summer dessert apple; useful also for culinary purposes. It ripens about the beginning of August, and continues in use for two or three weeks.

The tree forms a spreading head with straggling branches, and is not a strong grower, but healthy, and an excellent bearer.

This variety is of American origin, and was introduced into this country by the Horticultural Society. It is one of the few American apples that acquire a satisfactory degree of flavour in this country.

21. EARLY NONPAREIL—syn. Hicks' Fancy, New Nonpareil, Staggs' Nonpareil, Summer Nonpareil.—*Shoots* long and slender, upright, near the base and where shaded of a deep olive green, elsewhere of a bright chestnut colour, sprinkled with a few well-defined roundish or oval dots of a grayish colour, very slightly downy. *Leaves* middle-sized, roundish oval, or somewhat ovate, acuminate, crenated. Petioles of medium length and rather slender. *Flowers* middle-sized. Petals roundish oval. *Fruit* below the middle size, oblate, broadest at the base. Eye slightly open, set in a narrow, evenly formed, shallow cavity. Stalk short, rather thick, deeply inserted. Skin dull greenish yellow, covered with very thin brown russet, and thinly sprinkled with gray spots. Flesh yellowish white, crisp, and tender, with an abundance of rich, brisk juice, nearly approaching to the sprightly flavour of the Old Nonpareil.

A most excellent dessert apple; in season from October to December.

The tree is hardy and very productive, comes soon into bearing, and succeeds well as a dwarf on the Paradise stock.

The variety was raised from a seed of the

Old Nonpareil, about the year 1780, by a nurseryman of the name of Staggs, at Caister, near Yarmouth. It is highly deserving of cultivation; for, besides its good bearing properties, it affords a supply of fruit with the Nonpareil flavour, at a comparatively early period of the season.

22. EARLY RED MARGARET—syn. Margaret, Early Margaret, Margaretha, Marguerite, Red Juneating, Early Red Juneating, American Red Juneating, Striped Juneating, Early Striped Juneating, Striped June, Striped Quarrenden, Summer Traveller, Eve Apple in Ireland.—*Shoots* moderately strong, of a chestnut colour, sprinkled with well-defined whitish spots, downy towards the extremities. *Leaves* rather large, ovate, cordate at the base, acuminate, doubly serrated. Petioles rather long and strong. *Flowers* large, produced in thick clusters, chiefly towards the extremities of the branches. Petals roundish ovate, much imbricated, of a rich cream colour tinged with red. *Fruit* middle-sized, roundish ovate, tapering towards the eye, obtusely angular on the sides. Eye small, open, set in a very shallow basin, and surrounded by small plaits. Stalk short, thick, inserted in a medium-sized cavity. Skin greenish yellow, streaked with red, with sometimes a bright red cheek next the sun. Flesh white, crisp, and rich, with a brisk and very pleasant aromatic, sub-acid flavour.

One of the best of the early dessert apples; ripe about the beginning of August, but becoming mealy in a few days after gathering. It is best eaten fresh from the tree.

The tree is not a strong grower, but hardy, and a good bearer.

23. FEARN'S PIPPIN—syn. Clifton Nonesuch, Ferris Pippin, Florence Pippin.—*Shoots* moderately vigorous, purplish brown, very downy. *Leaves* scarcely middle-sized, longish ovate, tapering to the point, slightly serrated. Petioles long, rather slender. *Fruit* middle-sized, roundish oblate. Eye large, partially closed, placed in a wide, shallow, slightly plaited basin. Stalk short, not deeply inserted. Skin on the shaded side greenish yellow, changing to a fine golden colour, slightly intermixed with brownish red, when the fruit is fully ripe; next the sun dark red, marked with numerous small, whitish dots, and spots of brownish russet. Flesh whitish, firm, and rich, with an abundance of brisk, pleasant juice.

A handsome and excellent dessert apple, which is also suitable for kitchen use; in

season from November to February or March. It bears a close resemblance to the Court-pendû Plat, but may be distinguished from that sort by its being of a darker red next the sun, and by the white spots which occur at that part.

The tree is very hardy and a great bearer, but liable to canker in some soils. It is much cultivated for the London markets, and is well adapted for growing in orchards, the fruit not being liable to be blown down by the wind.

24. GOLDEN HARVEY—syn. Brandy Apple. — *Shoots* very slender, erect, reddish brown, covered with an epidermis of a silvery or leaden hue, slightly downy. *Leaves* small, ovate, acuminate, doubly and sharply serrated. Petioles rather long, slender. *Fruit* small, roundish, flattened at both ends. Eye small, open, inserted in a wide, very shallow depression. Stalk short, inserted in a shallow cavity of moderate width. Skin russet yellow on the shaded side, tinged with brownish red and spotted with russet next the sun. Flesh yellowish, firm, and exceedingly rich, with a high-flavoured, very sugary juice.

A dessert apple of great excellence; in season from December to May. It is also much esteemed as a cider fruit, from the very rich, saccharine quality of its juice.

The tree is hardy, but not a strong grower. It is generally a shy bearer, but should be in every gentleman's garden, on account of the fruit being rich and sound-keeping.

25. GOLDEN PIPPIN—syn. Balgone Golden Pippin, English Golden Pippin, Herefordshire Golden Pippin, London Golden Pippin, Milton Golden Pippin, Old Golden Pippin, Russet Golden Pippin, Warter's Golden Pippin, American Plate, Balgone Pippin, Bayfordbury Pippin, Pépin d'Or, Pomme d'Or, Koenings Pippeling, Reinette d'Angleterre.—*Shoots* of moderate vigour when the tree is healthy, remarkably short-jointed, chestnut-coloured beneath a thin pubescence, and marked with pale brown spots of various forms and sizes. *Leaves* small, roundish oval or ovate, slightly acuminate, sharply and doubly serrated. Petioles short, about $\frac{7}{16}$ ths of an inch in length. Stipules linear-lanceolate, about half the length of the petioles. *Fruit* small, generally roundish, sometimes oblate, or, on the contrary, inclining to oblong, outline regular. Eye small, open, set in a shallow, evenly rounded cavity. Stalk short, moderately thick, not very deeply

inserted. Skin, when fully ripe, of a rich golden yellow, with white specks appearing through it, generally clear, occasionally interspersed with small russet spots. Flesh yellow, firm, crisp, and rich, with an abundance of brisk, sugary juice.

A dessert apple so well known to be of the highest excellence, as to need no further eulogium. It is also an esteemed cider fruit. It is in use from November to April.

The tree does not succeed in many situations, but in some it does not exhibit such signs of decay as would warrant the correctness of the current opinion, that the variety is exhausted from old age. That such is not the case is proved by my friend Mr. Hogg, in his excellent work on *British Pomology*, p. 95, where an able account of this celebrated variety is given in detail. The tree should be planted in a favourable situation, in good, well-trenched soil, and, when it comes into a bearing state, it ought to be assisted with some good compost, introduced within reach of the extremities of the roots.

26. GOLDEN REINETTE—Syn. Kirke's Golden Reinette, Yellow German Reinette, Reinette d'Aix, Reinette Gielen, Reinette von Orleans, Aurore, Court-pendû Doré, Dundee, Elizabet, Englische Pippin, Megginch Favourite, Princesse Noble of the French, Wyger's, Wyker Pippin. — *Shoots* moderately strong, of a dark chestnut colour, partially covered with a silvery epidermis, and sprinkled with white spots, moderately downy. *Leaves* middle-sized, ovate, acuminate, doubly and sharply serrated, of a shining dark green. Petioles of medium length. *Fruit* middle-sized, depressed globular, with a regular outline. Eye large, open, set in a wide, shallow basin. Stalk sometimes short and thick, frequently 1 inch in length, and of medium thickness or rather slender, inserted in a middle-sized, evenly-formed cavity, the sides of which are generally covered with russet. Skin on the shaded side greenish yellow at first, of a golden colour when fully ripe; dull light red, lightly streaked with bright red next the sun; the whole surface covered, in general, more or less thickly with triangular russet scars. Flesh yellow, crisp, and rich, with a brisk, saccharine juice.

A handsome dessert apple, of the highest excellence; in season from November till January or February.

The tree is healthy, and a good bearer.

27. **HEREFORDSHIRE PEARMAIN**—syn. Old Pearmean, Royal Pearmain, Parmain Royal, Royale d'Angleterre.—*Shoots* vigorous, olive brown, sprinkled with few but distinct whitish specks, rather downy. *Leaves* middle-sized, broad oval, somewhat cordate, acuminate, sharply and doubly serrated. *Petioles* strong, nearly 1 inch in length. *Fruit* large, flat, pearmain-shaped, with a roundish outline, or but slightly angular on the sides. *Eye* middle-sized, open, placed in a wide, moderately deep, slightly plaited basin. *Stalks* short, inserted in a rather deep, evenly formed cavity. *Skin* dull green at first, changing to yellowish green, brownish red, and faintly streaked with red intermixed with russet next the sun. *Flesh* yellowish, firm, sugary, and rich, with a brisk, aromatic juice.

An old and deservedly esteemed apple, suitable both for the kitchen and dessert; in season from November till March.

The tree is of medium growth, hardy, and a tolerably good bearer. One of the best, if not the very best, of the Pearmain.

28. **HUBBARD'S PEARMAIN**.—*Shoots* moderately strong, olive brown, partially covered with a silvery epidermis somewhat reticulated near the base, like the one-year old bark of a hazel shoot, strewed with very few spots, slightly downy. *Leaves* middle-sized, oval, acuminate, sharply serrated. *Petioles* scarcely 1 inch in length. *Fruit* small, ovate, with a regular outline. *Eye* small, closed, set in a shallow depression. *Stalk* short, not deeply inserted. *Skin* sometimes smooth, but in general almost entirely covered with pale brown russet; where not so covered, of a yellowish green colour on the shaded side, dull brownish red next the sun. *Flesh* yellow, firm, very sweet, rich, and highly flavoured, though not very juicy.

A dessert apple of great excellence; in season from November till April.

The tree is hardy, and a great bearer.

29. **HUGHES' GOLDEN PIPPIN**—syn. Hughes' New Golden Pippin.—*Shoots* of moderate vigour, dark brown, sprinkled with whitish dots, partially covered with a silvery epidermis, rather downy. *Leaves* middle-sized, ovate, acuminate, doubly and sharply serrated. *Petioles* of medium length. *Fruit* rather small, globular or conical, flattened at both ends. *Eye* small, open, surrounded with slight plaits, and placed in a very shallow depression, or sometimes level with the top. *Stalk* very short,

thick, set in a very shallow cavity, frequently not at all sunk, but forming a knob-like projection from the base of the fruit. *Skin* russeted, yellowish green. *Flesh* yellow, firm, with a very rich, brisk flavour.

A very excellent winter dessert apple; in season from December to February.

The tree is not a strong grower, nor so productive as the Court of Wick and several other dessert kinds already mentioned, but, on account of the richness of the fruit, it is highly deserving of cultivation.

30. **IRISH PEACH APPLE**—syn. Early Crofton.—*Shoots* moderately strong, purplish brown, spotted with pale brown, thinly covered with white down. *Leaves* middle-sized, ovate, acuminate, irregularly serrated. *Petioles* of moderate length. *Fruit* middle-sized, roundish, somewhat depressed, obtusely angular on the sides. *Eye* small, nearly closed, set in a wide, shallow depression. *Stalk* short, thick, not deeply inserted. *Skin* yellowish green, sprinkled with numerous green or pale brown dots on the shaded side, marbled with brownish red and streaks of bright red next the sun. *Flesh* white, tender, crisp, rich, and sweet, with a pleasant, brisk, aromatic juice.

An excellent summer dessert apple; in use during August.

The tree is vigorous, and an abundant bearer.

31. **KERRY PIPPIN**—syn. Edmonton's Aromatic Pippin.—*Shoots* moderately strong, covered for the most part with a silvery epidermis, elsewhere of a chestnut colour, thinly set with whitish spots, downy towards the extremities. *Leaves* middle-sized, ovate, acuminate, doubly serrated. *Petioles* long and slender. *Fruit* middle-sized, oval, flattened at the eye, generally with one or more sharp ridges, extending from the base to the opposite extremity. *Eye* small, closed, set in a shallow, plaited basin. *Stalk* short, sometimes thickened at its insertion, set obliquely in a confined cavity, with a protuberance of the fruit on one side. *Skin* very smooth and polished, of a pale straw colour; when fully ripe, streaked and tinged with red next the sun, sometimes presenting a bright red cheek, streaked and tinged with a darker shade. *Flesh* yellowish, very firm for an early apple, but crisp, juicy, brisk, very rich, sugary, and highly flavoured.

A highly esteemed dessert apple; in season in September and October. Owing to its

firm, sugary flesh, it retains its flavour longer after gathering than most early apples.

The tree is hardy, and a great bearer.

32. KING OF THE PIPPINS—syn. Hampshire Yellow, Golden Winter Pearmain.—*Shoots* vigorous, of a dark chestnut colour, sprinkled with a few light brown spots, very downy at the extremities. *Leaves* middle-sized, ovate, acuminate, doubly but not deeply serrated. Petioles short. *Fruit* middle-sized, of a roundish pearmain-shape. Eye large, open, deeply sunk in a regularly formed, slightly plaited hollow. Stalk short, inserted in a rather shallow cavity. Skin smooth, pale orange on the shaded side, orange tinged with red, and faintly streaked with a deeper red next the sun. Flesh yellowish white, tender, very sweet and juicy, with a tolerably rich, pleasant flavour.

A very beautiful and much esteemed dessert apple; in season from October till January, but in perfection during November.

The tree is very hardy, vigorous, and a most abundant bearer.

33. LAMB ABBEY PEARMAIN.—*Shoots* slender, of a dull chestnut colour, strewed with whitish spots, slightly downy. *Leaves* middle-sized, ovate, acuminate, sharply and doubly serrated. Petioles of medium length. *Fruit* rather small, oval or oblong, somewhat depressed at each end, tapering slightly towards the eye, without angles on the sides. Eye small, open, set in a wide, rather deep, slightly plaited basin. Stalk short, deeply inserted in a narrow cavity. Skin greenish yellow on the shaded side, orange yellow streaked with dull red, and sprinkled with numerous small dark coloured dots next the sun. Flesh yellowish green, very firm, crisp, juicy, rich, and sweet.

A valuable dessert apple, which keeps without shrivelling; in use from January till May, or even later.

The tree is of medium size, and a good bearer.

34. MARGIL—syn. Muscat Reinette, Never-fail, Small Ribston, Munche's Pippin of some.—*Shoots* slender, purplish brown, sprinkled with numerous small, whitish dots, moderately downy. *Leaves* small, ovate-lanceolate, somewhat acuminate, regularly serrated. Petioles long, slender. *Flowers* middle-sized. Petals longish ovate, pale pink. *Fruit* small, roundish ovate, angular on the sides. Eye small, closed, surrounded by ridges formed by the terminations of the angles on the sides. Stalk

short, slender, deeply inserted. Skin pale orange, with a sprinkling of thin russet, and streaked with dull red next the sun. Flesh yellow, firm, very rich, juicy, and sweet, with a flavour like that of the Ribston Pippin, only more aromatic.

An excellent table apple; in season from November to March.

The tree is of very dwarf, slender habit, hardy, and an abundant bearer; so much so that, if care is not taken to thin spurs and encourage young wood, it is apt to overbear itself.

It is exceedingly well adapted for situations where trees of low growth only can be cultivated. It may also be successfully grown as an espalier.

35. NEW ROCK PIPPIN.—*Shoots* long, slender, of a bright chestnut colour, thinly set with white spots, moderately downy. *Leaves* middle-sized, oval, acuminate, serrated. Petioles short. *Fruit* small or middle-sized, roundish, depressed. Eye small, nearly closed, placed in a slight depression, and surrounded by small plaits. Stalk short, thick, inserted in a wide, rather shallow cavity. Skin green at first, changing to a dull yellowish green on keeping; brownish red next the sun, slightly russeted, and sometimes exhibiting patches of a silvery or pearl gray-epidermis. Flesh yellowish white, firm, crisp, not very juicy, but brisk-flavoured.

A very good table apple; in season from January till May.

The tree is hardy, and an excellent bearer.

36. NEWTOWN PIPPIN—syn. American Newtown Pippin, Green Newtown Pippin, Hunt's Green Newtown Pippin, Large Newtown Pippin, Green Winter Pippin, Hunt's Fine Green Pippin, Petersburg Pippin.—*Shoots* moderately strong, of a bright chestnut colour, set with numerous small whitish dots, slightly downy. *Leaves* rather small, ovate, acuminate, regularly serrated. Petioles of medium length, slender. *Fruit* middle-sized, roundish, somewhat flattened, with broad flat ribs on the sides, and extending to the crown, where they become very prominent, like those of the London Pippin. Eye small, open, set in a rather shallow basin. Stalk half an inch long, inserted to its full length in a wide, deep cavity. Skin green at first, changing, when fully ripe, to a greenish yellow; tinged with brown, and frequently of a light brown colour next the sun, a portion near the base

and the sides of the cavity in which the stalk is inserted being covered with thin russet. Flesh yellowish white, firm, crisp, and very juicy, with a peculiarly brisk, rich flavour when fully matured.

A dessert apple of the highest excellence; in season from December till April.

The tree is too delicate to ripen its fruit well as a standard in most situations in Britain, and the fruit produced upon walls rarely attains the same degree of perfection as that imported from America.

37. OLD NONPAREIL—syn. Due d'Arsel, English Nonpareil, Grune Reinette, Hunt's Nonpareil, Loveden's Pippin, Nonpareil, Nonpareil d'Angleterre, Reinette Nonpareil. — *Shoots* long, slender, upright, of a reddish chestnut colour, thinly sprinkled with whitish dots, very slightly downy. *Leaves* rather small, oval, acuminate, finely serrated. *Petioles* rather more than 1 inch in length, erect, slender. *Flowers* of medium size. *Petals* ovate. *Fruit* rather below the middle size, roundish, flattened, and broadest at the base. Eye very small, nearly closed, set in a very slight plaited depression. Stalk about 1 inch in length, slender, inserted in a wide cavity of moderate depth. Skin greenish yellow, intermixed with thin pale brown russet, occasionally of a deep reddish brown where much exposed to the sun, and sometimes almost completely covered with thin russet. Flesh pale yellowish green, firm, crisp, rich, and sugary, with an abundance of sprightly juice, of a peculiar and highly aromatic flavour.

One of the best of late winter and spring table apples; in season from January to May.

The tree is of rather small growth, somewhat tender, and apt to canker in cold, moist soils; but it thrives and bears very well in good soils and favourable situations. It succeeds well as a standard in the southern and midland counties of England; more to the north, except in warm situations, it requires and deserves a wall. It may be grown in pots when grafted on the Paradise stock.

The variety is supposed to have been introduced from France, by a Jesuit, in the sixteenth or seventeenth century.

38. ORD'S APPLE.—*Shoots* moderately strong, of a dark chestnut brown colour, strewed with a few pale gray spots, and mostly covered with gray pubescence. *Leaves* below the middle size, ovate, acuminate, sharply and irregularly serrated. *Petioles* nearly 1 inch in length,

slender, erect. *Fruit* middle-sized, oblong, inclining to ovate, somewhat flattened at both ends, obtusely ribbed on the sides. Eye small, closed, set in a narrow, rather deep, plaited basin. Stalk short, obliquely inserted in a narrow, irregularly formed cavity. Skin dark green, tinged with light brownish red, and marked with numerous large rust-coloured spots on the side next the sun. Flesh greenish, firm, and crisp, with an abundance of rich, brisk juice, scarcely surpassed in its refreshing qualities by that of any other apple.

A most excellent dessert apple; in season from January to May, and having the valuable property of retaining its briskness when the flavour of most other apples has become flat.

The tree is hardy, and an excellent bearer.

The variety was obtained by Mrs. Anne Simpson, in the garden of her brother-in-law, John Ord, Esq., at Purser's Cross, near Fulham, and originated from a seedling raised by him from the pip of an imported Newtown Pippin.

39. OSLIN—syn. Arbroath Pippin, Orgeline, Orjeline, Original Pippin, Summer Oslin, White Oslin.—*Shoots* rather slender, short-jointed, of upright growth, dull grayish purple, speckled with pale brown, moderately downy. *Leaves* middle-sized, roundish, or even of greater dimensions across than from the base to the apex, abruptly acuminate, irregularly serrated. *Petioles* of medium length. *Fruit* middle-sized, roundish oblate, without angles on the sides. Eye small, closed, nearly prominent, surrounded by a few large plaits. Stalk short, thick, inserted in a wide, shallow cavity. Skin pale yellow, sprinkled with numerous greenish specks and small dark brown dots, of thick texture, and often deeply cracked. Flesh yellowish white, firm, crisp, very rich, sweet, and juicy, with a peculiar, brisk, and highly aromatic flavour, which chiefly resides in and near the skin. On this account, the skin should be pared off as thinly as possible.

A dessert apple, surpassed by none in the excellence of its flavour. It is in season in August and September.

The tree is of medium size, tolerably hardy, and a good bearer; but when old, planted in very rich soil, or much confined by other trees, it is very subject to canker. Grown in highly manured soil, the fruit does not acquire its aromatic flavour.

The variety is supposed either to have been

raised at Arbroath, or, what is more probable, to have been introduced from France by the monks of the abbey.

40. PEARSON'S PLATE.—*Shoots* long, slender, light brown, set with small, whitish spots, moderately downy. *Leaves* middle-sized, oval, acuminate, doubly serrated. Petioles of medium length, rather slender. *Fruit* small, roundish oblate, with a regular outline. Eye generally open, frequently closed, set in a broad, shallow, slightly plaited basin. Stalk sometimes 1 inch in length, and slender, frequently very short and thick, seldom deeply inserted. Skin smooth, yellowish green on the shaded side, tinged and streaked with a rich, bright red, and strewed with light brown spots next the sun, the whole occasionally thinly sprinkled with russet. Flesh greenish yellow, firm, juicy, very rich, sugary, brisk, and excellent.

A handsome dessert apple, of peculiar excellence; in season from December to March.

The tree is healthy, but not a strong grower; and it is well adapted for dwarf training.

41. PITMASTON GOLDEN HARVEY.—*Shoots* slender, of a light chestnut brown, sprinkled with a few inconspicuous spots, thinly coated with gray pubescence. *Leaves* middle-sized, oval, of thin texture, acuminate, sharply and deeply serrated. Petioles about 1 inch in length, slender. *Fruit* small, but larger than that of the Golden Harvey, which it resembles in form, roundish, flattened at both ends. Eye small, close, rather deeply sunk. Stalk nearly 1 inch in length, inserted in a wide, rather shallow cavity. Skin with a ground colour of an orange tinge, scarred, and sometimes thickly coated with russet. Flesh yellowish, firm, rich, and sugary, with a brisk, sub-acid juice.

A very excellent dessert apple; in season from January till May.

The tree is more vigorous than the Golden Harvey, from a seed of which, fertilized with the pollen of the Yellow Siberian Crab, it sprung. It was raised by John Williams, Esq., of Pitmaston.

42. PITMASTON GOLDEN PIPPIN.—*Shoots* tolerably vigorous, of a light chestnut brown, thinly sprinkled with pale brownish spots, slightly downy, bearing considerable resemblance to those of the old Golden Pippin, but more vigorous. *Leaves* small, oval or ovate, acuminate, slightly serrated. Petioles short. *Fruit* small, roundish ovate, somewhat flat-

tened at both ends. Eye small, open, set in a wide, shallow depression. Stalk short, rather slender. Skin of a golden yellow, intermixed with russet. Flesh yellow, firm, rich, and very sweet.

An excellent dessert apple; in use during December, January, and February.

The variety was raised by Mr. Williams of Pitmaston.

43. PITMASTON NONPAREIL—syn. Pitmaston Russet Nonpareil.—*Shoots* not so long as those of the Old Nonpareil, but much stronger, dark olive brown, covered with a silvery epidermis, strewed with a few spots, very downy near the extremities, slightly so at the base. *Leaves* middle-sized, ovate, concave, rather sharply serrated. Petioles about 1 inch in length. *Fruit* middle-sized, roundish, and depressed, tapering towards the apex. Eye small, open, set in a wide, shallow, slightly plaited cavity. Stalk short, slender, not deeply inserted. Skin pale green, tinged with red next the sun, the whole surface almost entirely covered with russet. Flesh pale yellowish green, moderately firm, rich, and excellent, with a brisk Nonpareil flavour.

A most excellent dessert apple; in season during December, January, and February.

The tree is more vigorous and hardy than the Old Nonpareil, and is also a more abundant bearer; the fruit, grown under equal circumstances, is also larger.

The variety was raised by John Williams, Esq., of Pitmaston.

44. PITMASTON PINE APPLE.—*Shoots* vigorous, of a bright chestnut colour, tinged with olive near the base, very slightly downy. *Leaves* middle-sized, oval, acuminate, sharply serrated. Petioles scarcely 1 inch in length. *Fruit* small, tapering a little towards the top, which is flattened. Eye small, partially open, set in a shallow depression. Stalk short, not deeply inserted. Skin of a rich orange colour, partially covered with russet. Flesh yellow, firm, very rich, sugary, and aromatic.

A dessert apple, of first-rate excellence; in season from December to March.

This variety was also raised by Mr. Williams.

45. RED ASTRACHAN.—*Shoots* strong, of a clear chestnut colour, thinly sprinkled with well-defined whitish dots, very slightly downy. *Leaves* middle-sized, roundish oblong, somewhat acuminate, obtusely serrated. Petioles of medium length and thickness. *Fruit* rather above the medium size, roundish, or roundish

oblong. Eye small, closed, rather deeply inserted, surrounded by irregular protuberances. Stalk short, deeply inserted. Skin greenish yellow on the shaded side, of a fine deep crimson next the sun, everywhere covered with a fine white bloom. Flesh white, crisp, and sweet, with an abundance of brisk, pleasant juice.

A beautiful dessert apple, which ripens in August, but does not keep long.

The tree is vigorous, of upright growth, hardy, and an excellent bearer.

46. REINETTE DU CANADA—syn. Reinette du Canada blanche, Reinette du Canada à côtes, Reinette Grosse du Canada, Canada Reinette, Reinette de Caen, Reinette Grosse d'Angleterre, Wahre Reinette, Pomme de Bretagne, Pomme du Canada, Portugal Apple, St. Helena Russet, Mela Janurea of the Ionian Islands.—*Shoots* strong, spreading, of a dark chestnut colour, thinly strewed with small, light brown spots, covered here and there with patches of a grayish epidermis, very woolly towards the extremities. *Leaves* middle-sized, cordate, acuminate, obtusely serrated. Petioles short, very thick, downy. *Flowers* rather large. Petals oval, cordate at the base, not much imbricated. *Fruit* very large, broad at the base, flatly conical, with an irregular outline, obtusely ribbed; the ribs being prominent towards the eye, diminishing as they pass downwards. Eye large, half open, inserted in a wide, plaited cavity. Stalk short, generally rather thick, deeply set in a wide hollow. Skin greenish yellow, tinged with brown and sometimes red next the sun, strewed more or less with dots and scars of brown russet. Flesh yellowish white, firm, and rich, with a brisk juice of a Nonpareil flavour.

A large and esteemed kitchen apple, and surpassed by none of so large a size for the dessert. It is in season from November to April.

The tree is vigorous, and a good bearer.

47. REINETTE DE LAAK.—*Shoots* vigorous, of a reddish chestnut colour, thinly sprinkled with small dots, very slightly pubescent. *Leaves* large, ovate, tapering to the point, sharply serrated. Petioles of medium length. *Fruit* middle-sized, roundish, inclining to conical, without angles on the sides. Eye a little open, set in a slightly plaited, shallow basin. Stalk short, thickened at its insertion, placed obliquely in an evenly rounded cavity. Skin smooth, of a fine golden yellow, streaked with

red next the sun. Flesh white, tender, and juicy, with an agreeable, sub-acid flavour.

A remarkably handsome dessert apple, in use during September.

The tree is vigorous, and a great bearer.

48. RIBSTON PIPPIN—syn. Formosa Pippin, Glory of York, Travers' Apple.—*Shoots* strong, spreading, light chestnut, thinly strewed with small, roundish spots, of a whitish colour, very downy towards the extremities. *Leaves* middle-sized, broad oval, somewhat acuminate, serrated, covered beneath with a thick silvery down. Petioles of medium length and thickness. *Flowers* middle-sized. Petals ovate. *Fruit* rather above the middle size, roundish, somewhat flattened, obtusely angular on the sides. Eye large, nearly closed, slightly sunk in an irregular, plaited basin. Stalk short, of medium thickness, woolly, generally inserted to its full length in a moderately large cavity. Skin deep greenish yellow, marked with broken streaks and specks of pale crimson on the shaded side, brownish red streaked with dark crimson next the sun, frequently russety about the eye, also near the base; and there the yellow streaks appearing obscurely through the russet, give it a rich appearance. Flesh yellow, firm, and crisp, with a rich, saccharine juice, and highly aromatic flavour.

A dessert and kitchen apple of the highest excellence; in season from November to March, but generally in greatest perfection about Christmas.

The tree is generally grown on walls in the north, where its produce is more juicy and crisp than in the south; for there its flesh is liable to be deficient in moisture, especially when grown in dry soils. The soil for it should be well drained and deeply trenched to retain moisture.

The variety, according to tradition, was raised from some apple seeds brought from Rouen, about 170 years ago, and sown in the garden at Ribston Hall, near Wetherby, in Yorkshire. However this may be, the parent tree existed there till 1835, when it died. That this was the original seedling, and not a grafted tree, was thought to have been conclusively proved, from the circumstance that rooted suckers, which were planted in the garden of the Horticultural Society at Chiswick, produced fruit exactly the same as that borne by the grafted trees. But Mr. May, a nurseryman at Bedale, states that the tree

had been grafted on the Paradise stock, and that the rooted suckers originated above the graft after the tree had become bent to the ground on one side.

49. SAM YOUNG—syn. Irish Russet.—*Shoots* moderately strong, spreading, of a dull purplish brown, thinly strewn with pale gray dots, moderately downy. *Leaves* middle-sized, ovate, cordate at the base, acuminate, obtusely crenated. Petioles short, moderately thick. *Fruit* small, oblate. Eye large, open, set in a wide, shallow depression, the sides of which are slightly plaited. Stalk short, thick, inserted in a shallow cavity. Skin russet brown, very apt to crack. Flesh yellowish and firm, with a brisk, rich, sugary juice, and high flavour.

A dessert apple of great merit, but apt to crack; in season from November to February.

The tree is of medium size, and a good bearer.

50. SCARLET CROFTON—syn. Red Crofton.—*Shoots* slender, of a light chestnut colour, distinctly marked with small white spots, downy. *Leaves* small, roundish obovate, somewhat acuminate, serrated. Petioles short. *Fruit* middle-sized, oblate. Eye large, inserted in a wide, very shallow depression, or nearly level with the top of the fruit. Stalk short, not deeply inserted. Skin greenish yellow, intermixed with slight brown russet on the shaded side, bright red and russeted next the sun; the whole traced or irregularly reticulated with russet veins. Flesh yellow, crisp, juicy, rich, and highly flavoured.

A favourite Irish table apple; in season from October to December.

The tree is of medium size, and a good bearer.

51. SCARLET NONPAREIL—syn. New Scarlet Nonpareil.—*Shoots* long, rather slender, of a bright chestnut colour, covered with a silvery epidermis, and thinly sprinkled with whitish dots, slightly downy. *Leaves* middle-sized, ovate, acuminate, sharply serrated. Petioles of medium length. *Fruit* middle-sized, roundish, a little depressed, without angles on the sides. Eye rather large, open, set in a shallow, very slightly plaited basin. Stalk usually about 1 inch long, thickened at its insertion, sometimes merely a short, fleshy knob; it is set in an evenly rounded shallow cavity. Skin yellowish green on the shaded side, deep red, slightly streaked with a darker shade, and covered with small pale brown spots next the

sun. Flesh yellowish white, firm, juicy, rich, sweet, and excellent.

A much esteemed and beautiful dessert apple; in use in January, February, and March.

The tree is hardy, and a great bearer.

52. SCARLET PEARMAIN—syn. Bell's Searlet, Oxford Peach.—*Shoots* long, rather slender, of a bright chestnut colour, marked with small brown spots, slightly downy. *Leaves* small, oval, acuminate, doubly serrated. Petioles long, slender. *Fruit* middle-sized, conical, with a regular outline. Eye middle-sized, partially open, the segments of the calyx remaining green, sunk in a rather deep, slightly plaited cavity. Stalk about 1 inch in length, slender, deeply inserted. Skin red, intermixed with yellow on the shaded side, of a rich bright crimson next the sun. Flesh yellowish white, tender, and sugary, with an abundance of rich juice.

A very handsome dessert apple; in season from September to January.

The tree is healthy, and a good bearer.

53. STURMER PIPPIN.—*Shoots* vigorous, of a dark chestnut colour, sprinkled with small whitish dots, which are most numerous near the base, slightly downy at the extremities. *Leaves* middle-sized, ovate, acuminate, acutely crenated. Petioles of medium length. *Fruit* middle-sized, shortly conical, somewhat flattened at both ends. Eye small, closed, placed in a shallow, irregularly formed cavity. Stalk of medium length, inserted in a deep, evenly formed hollow. Skin yellowish green on the shaded side, of a dark brownish red next the sun. Flesh yellowish, firm, crisp, and sweet, with an abundance of brisk juice, and a slight Ribston Pippin flavour.

One of the best late dessert apples known, for it is neither apt to shrivel nor lose its briskness. It is useful also for culinary purposes, and is in use from February till June.

The tree is healthy, and an abundant bearer. It should be in every collection.

The variety was raised at the nursery of Mr. Dillistone, at Sturmer, in Suffolk, and was obtained by impregnating the Ribston Pippin with the Old Nonpareil.

54. SUMMER GOLDEN PIPPIN—syn. White Summer Pippin, Summer Pippin of some.—*Shoots* below the average length, of moderate thickness, short-jointed, olive, sprinkled with a few not very conspicuous spots, very slightly downy. *Leaves* roundish oval, sometimes nearly round, shortly acuminate, slightly serrated.

Petioles from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length. *Fruit* rather small, ovate, flattened at both ends. Eye open, set in a shallow, evenly formed basin. Stalk short, inserted in a cavity of moderate size. Skin smooth, pale yellow on the shaded side, of a brighter yellow and tinged with brown next the sun. Flesh yellowish white, firm, very rich, and sugary.

An excellent dessert apple; fit for use in August or the beginning of September, but not keeping in full perfection longer than a fortnight; yet it does not lose its flavour so soon as most others ripening at the same early period.

The tree is of moderate vigour, and a good bearer.

55. SUMMER THORLE—syn. Watson's Nonesuch, Whorle Pippin. — *Shoots* moderately strong, olive brown, sprinkled with a few spots, mostly covered with gray pubescence. *Leaves* small, cordate, somewhat acuminate, irregularly serrated. Petioles about 1 inch in length. *Fruit* rather below the middle size, oblate, with a regular outline. Eye large, partially closed, placed in a wide, shallow depression. Stalk very short, thick, not deeply inserted. Skin smooth, pale yellow and marked with broken streaks of pale red on the shaded side, bright red streaked with a deeper colour next the sun. Flesh white, crisp, tender, with an abundance of brisk, pleasant juice.

A handsome, early dessert apple, ripening in August and September.

The tree is hardy, suited for northern climates, and a most abundant bearer.

56. SYKE HOUSE RUSSET—syn. Syke House, Reinette des Hôpitaux, Englische Spitalsreinette. — *Shoots* slender, of a dull chestnut brown, sprinkled with some minute spots, and thinly coated with grayish pubescence. *Leaves* small, oval, slightly cordate at the base, somewhat acuminate, slightly serrated. *Fruit* below the middle size, oblate. Eye small, set in a deep, slightly plaited cavity. Stalk generally short, moderately thick, inserted in a shallow depression. Skin on the shaded side yellowish green, sometimes entirely covered with russet, frequently with only a few russety spots and patches; deep brown next the sun. Flesh yellowish white, firm, rich, with a brisk, highly flavoured, sub-acid juice.

A sound keeping dessert apple of great excellence; in use from November till February.

The tree is of moderate growth, hardy, and an abundant bearer.

The variety takes its name from the village of Syke House, in Yorkshire; but, from its being closely allied to the Reinettes Grises, it is not improbable that it may have been carried there from the Continent.

57. WHITE ASTRACHAN—syn. *Pyrus astrachanica*, D. C., Glace de Zélande, Pomme d'Astrachan, Transparente de Moscovie. — *Shoots* rather strong, bright chestnut red, speckled with pale brown, slightly woolly. *Leaves* middle-sized, oval or somewhat ovate, slightly acuminate, obtusely and finely serrated. Petioles scarcely 1 inch in length. *Flowers* middle-sized. Petals roundish, white, tinged with pink. *Fruit* middle-sized, shortly conical, flattened towards the base, angular on the sides; the angles rather flat at the base, more prominent towards the eye, round which they form obtuse plaits. Eye closed, set moderately deep in a small cavity. Stalk very short, thick, inserted in a very shallow, even hollow. Skin smooth, greenish white, often with faint reddish streaks next the sun, covered with a very slight white bloom. Flesh snow white, very transparent, crisp, tender, juicy, and of a pleasant flavour.

A dessert apple ripening in August or the beginning of September, but soon decaying.

The tree is moderately vigorous, hardy, and a good bearer.

58. WHITE JUNEATING—syn. Joanneting, Juneating, Owen's Golden Beauty, Primiting in Kent and Sussex. — *Shoots* moderately strong, brown, with a chestnut tinge where well exposed, sprinkled with a few light brown dots, rather downy. *Leaves* middle-sized, roundish oval, acuminate, not deeply serrated. Petioles about 1 inch in length. *Fruit* small, roundish, slightly depressed. Eye small, closed, set in a very shallow, slightly plaited cavity. Stalk short, slender, not deeply inserted. Skin smooth, pale yellow, sometimes tinged with orange or pale red next the sun. Flesh white, crisp, and sweet, with a brisk and very pleasant juice.

A handsome and very good early dessert apple, ripening in the end of July and beginning of August, but not keeping good for more than a week.

The tree is of rather dwarf habit, and a very abundant bearer.

59. WORMSLEY PIPPIN—syn. Knight's Codlin. — *Shoots* very strong, of a dark brown colour, covered with a silvery epidermis, strewed with small, roundish, pale gray spots,

slightly downy. *Leaves* large, ovate, cordate at the base, acuminate, sharply and doubly serrated. *Petioles* about 1 inch in length. *Flowers* middle-sized. *Petals* oval, somewhat cordate at the base. *Fruit* rather large, roundish, obtusely angular on the sides. *Eye* large, open, set in a narrow, deep, irregularly formed cavity. *Stalk* short, deeply inserted. *Skin* pale greenish yellow, tinged with orange or brown next the sun, strewed with numerous small brownish dots. *Flesh* white, tender, melting, and sugary, with a brisk, high-flavoured, refreshing juice.

A most excellent dessert apple, and of great merit for kitchen use, requiring but little sweetening. It is in use during September, October, and November.

The tree is vigorous, attaining a large size, very hardy, and a great bearer.

This variety was raised by the late T. A. Knight, Esq., and communicated by him to the Horticultural Society, in 1811. It takes its name from Wormsley Grange, in Herefordshire, where he at one time resided.

II.—KITCHEN APPLES.

60. ALEXANDER—syn. Aporta, Emperor Alexander, Russian Emperor, Kaiser Alexander von Russland.—*Shoots* strong, brownish violet, sprinkled with small, oval, or linear specks, slightly downy. *Leaves* large, thin, roundish oval, acuminate, coarsely serrated. *Petioles* of medium length and strength. *Fruit* very large, shortly conical, with a regular outline. *Eye* large, deeply sunk in an evenly formed cavity. *Stalk* about 1 inch in length, slender, deeply inserted. *Skin* smooth, yellow, with a few broken streaks of red on the shaded side, of a deeper yellow and streaked with bright red next the sun, the whole surface covered with a fine bloom. *Flesh* yellowish, soft, sweet, not very juicy, of an agreeable though not high flavour.

A large but light kitchen apple of a very beautiful appearance; in season from September to December.

The tree is vigorous and a good bearer. It should be planted so as to be well exposed to the light, in order that the fruit may acquire its proper colour.

The variety is of Russian origin, and was introduced into this country, in 1817, by Mr. Lee of Hammersmith; but it is supposed to have been brought to Twickenham some years previously.

61. ALFRISTON—syn. Lord Gwyder's Newtown Pippin, Oldaker's New, Shepherd's Pippin, Shepherd's Seedling, Baltimore and Newtown Pippin of some.—*Shoots* strong, chestnut red, much spotted with pale brown, slightly downy. *Leaves* ovate or oblong, with a long tapering apex, regularly serrated. *Petioles* rather long. *Fruit* very large, roundish, with obtuse angles on the sides. *Eye* nearly closed, rather deeply set in a moderately large and tolerably even cavity. *Stalk* short, thick, deeply inserted. *Skin* greenish, veined with russet next the sun, slightly mottled with grayish white where shaded. *Flesh* yellowish white, crisp, and very juicy.

An excellent kitchen apple; in season from November till April.

The tree is vigorous, hardy, and a good bearer.

62. BEAUTY OF KENT—syn. Kentish Pippin of some.—*Shoots* strong, olive brown, moderately sprinkled with pale gray specks, slightly downy. *Leaves* large, broad oval or ovate, acuminate, coarsely and irregularly serrated. *Petioles* of medium length. *Fruit* large, somewhat conical, flattened at the base, and slightly so at the apex. *Eye* small, closed, set in a narrow, angular cavity. *Stalk* short, inserted in a large hollow. *Skin* on the shaded side greenish yellow, with numerous pale spots, next the sun mostly covered with broken streaks and blotches of red. *Flesh* yellowish white, tender, juicy, and sub-acid.

A very good kitchen apple; in season from October to February.

The tree is hardy, vigorous, and a good bearer; but, according to Mr. Hogg, always subject to canker when grown on the Paradise stock, and in moist and heavy soils.

63. BEDFORDSHIRE FOUNDLING—syn. Cambridge Pippin.—*Shoots* remarkably vigorous, chestnut-coloured with a violet hue, partially covered with a silvery epidermis, and marked with a considerable number of pale brown spots, moderately downy. *Leaves* very large, broad oval, acuminate, doubly and very sharply serrated. *Petioles* nearly 1 inch in length. *Fruit* very large, roundish, broadest at the base, obtusely angular on the sides, the angles prominent, and forming plaits round the eye. *Eye* large, open, inserted in a broad, rather deep hollow. *Stalk* short, inserted in a rather large, even cavity. *Skin* greenish yellow on the shaded side, slightly tinged with orange and thinly speckled with slight russet next

the sun. Flesh yellowish white, tender, and juicy, with a pleasant sub-acid flavour.

A very large, handsome, and excellent kitchen apple; in use from November to March.

The tree is a very strong grower, and a good bearer after it has attained a considerable size.

64. BURR KNOT—syn. Burr Apple.—*Shoots* slender, light chestnut, marked with very few gray dots, but mostly covered with thick gray pubescence. *Leaves* small, ovate, somewhat cordate at the base, slightly acuminate, with obtuse, moderately deep serratures. *Fruit* middle-sized, shortly conical. Eye large, nearly closed, rather deeply placed. Stalk short, inserted in a wide cavity. Skin smooth, yellow, brownish yellow next the sun. Flesh white and tender, with a sub-acid flavour.

A very good kitchen apple; in season from October to January.

The tree is of upright growth, rather dwarf in habit, and a moderate bearer. Numerous excrescences, like callosities of cellular tissue, form upon the branches, and if covered with earth, they readily strike root.

65. CARLISLE CODLIN.—*Shoots* moderately strong, brownish violet, sprinkled with a few roundish, gray dots, slightly downy. *Leaves* rather large, cordate, acuminate, rather sharply but not deeply serrated. Petioles about 1 inch in length. *Fruit* nearly of the medium size, ovate, or conical. Eye closed, set in a small, plaited cavity. Stalk slender, upwards of 1 inch in length, inserted in a small, narrow cavity. Skin pale greenish yellow. Flesh white, tender, with a brisk sub-acid juice.

An excellent kitchen apple; best from August to October, but continuing good till December. It may be used at a very early stage of its growth, and is then a very good sauce apple.

The tree is of medium size, hardy, and a good bearer.

66. DUMELOW'S SEEDLING—syn. Dumelow's Crab, Duke of Wellington's, Normanton Wonder, Wellington.—*Shoots* vigorous, dark brown, very thickly set with whitish dots, slightly downy. *Leaves* middle-sized, roundish oblong, acuminate, irregularly serrated. Petioles about 1 inch in length. *Fruit* large, roundish, flattened at each end. Eye large, open, rather deeply inserted in an irregular hollow. Stalk short, placed in a small cavity. Skin smooth, pale yellow on the shaded side, tinged with a blush of light red next the sun, and when much exposed, bright red on that

side. Flesh yellowish white, firm, crisp, with an abundance of brisk, acid juice.

One of the best long-keeping kitchen apples; in season from November to March, and not apt to shrivel or lose its briskness.

The tree is vigorous, hardy, and an abundant bearer.

The variety was raised by a farmer called Dummeller, of Shackerstone, near Ashby-de-la-Zouch; and was first brought into notice by Mr. Williams, nurseryman, of Turnham Green, who, in 1820, exhibited the fruit to the Horticultural Society, under the name of the Wellington Apple, the designation by which it is still best known in Covent Garden.

67. DUTCH CODLIN—syn. Chalmers' Large.—*Shoots* very strong, brownish chestnut, with a tinge of violet, partially covered with a silvery epidermis, and sprinkled near the base with a few pale dots, moderately downy. *Leaves* very large, broad ovate or somewhat cordate, slightly acuminate, doubly and sharply serrated. Petioles short. *Fruit* very large, roundish oblong, obtusely angular on the sides. Eye small, deeply sunk in an angular cavity. Stalk short, thick, inserted in a rather wide, irregular cavity. Skin smooth, yellowish green, with a bright brown tinge next the sun, when well exposed. Flesh white and tender, with a pleasant sub-acid juice. Core large and open.

An excellent kitchen apple; in season in August and September.

The tree is vigorous; and although the fruit is rather thinly set, yet, owing to its large size, the crop is often heavy.

68. GLORIA MUNDI—syn. American Gloria Mundi, Glazenwood Gloria Mundi, New York Gloria Mundi, American Mammoth, Josephine, Ox Apple, Baltimore of some.—*Shoots* long, vigorous, erect, of a bright reddish chestnut colour, thickly sprinkled with very small pale yellowish brown dots, very slightly downy. *Leaves* large, concave, roundish oval, acuminate, slightly serrated. Petioles about 1 inch in length. *Fruit* very large, roundish or roundish oblong, somewhat flattened at both ends, obtusely angular on the sides. Eye large, open, set in a wide, rather deep, slightly plaited basin. Stalk short, thick, deeply inserted. Skin smooth, greenish yellow, tinged with red next the sun, and having numerous small whitish spots appearing as if beneath it. Flesh white and firm, with a rich, brisk, acid juice.

A very good kitchen apple; in season from November to January, and not apt to shrivel.

The tree is vigorous, a moderate bearer, and deserving of cultivation, especially where fruit of a very large size is desired.

69. **GOLDEN NOBLE.**—*Shoots* vigorous, of a chestnut colour towards the extremities, olive brown near the base, moderately sprinkled with white spots, slightly downy. *Leaves* large, ovate, tapering to the point, doubly crenated. Petioles about 1 inch in length. *Fruit* large, roundish, very regularly formed. Eye small, closed, shallow. Stalk short, inserted in an evenly rounded hollow, and sometimes having a fleshy projection on one side, connecting it with the fruit. Skin of a fine golden yellow, with sometimes a few patches of thin russet. Flesh yellowish, with a pleasant acid.

A first-rate kitchen apple, in season from October till February. According to Lindley, it bakes of a fine clear amber colour, and is then perfectly melting, with a rich acidity.

The tree is vigorous, an excellent bearer, and highly deserving of cultivation.

70. **GRAVENSTEIN** — syn. Gräfensteiner, Grave Slije, Sabine of the Flemings.—*Shoots* strong, spreading, dark purplish red, sprinkled with a few whitish dots, moderately downy. *Leaves* rather large, broad ovate, acuminate, serrated or acutely crenated. Petioles moderately long, strong. *Flowers* very large. Petals roundish ovate, much imbricated. *Fruit* rather large, roundish, broadest at the base, generally somewhat flattened, angular on the sides, the angles forming large plaits surrounding the eye. Eye large, open, deeply inserted. Stalk short and rather thick, placed in a deep, rather wide cavity. Skin smooth, yellowish green or pale yellow on the shaded side, streaked and mottled with various shades of pale red and crimson next the sun. Flesh yellowish when the fruit is fully ripe, semi-transparent, crisp, tender, and very rich, abounding with a highly sugared juice, which, in warm seasons, is almost like a syrup.

Excellent for kitchen use, and particularly valuable as a sauce apple. It is also serviceable for the dessert. It is in season from October to December.

The tree is tolerably hardy, and a good bearer, but it requires a good warm soil, not too dry, and a warm season and situation, otherwise the fruit does not come to full perfection.

71. **GREEN APPLE.**—*Fruit* middle-sized, roundish, somewhat flattened at both ends, and having a very regular outline. Eye small,

close, set in a small cavity, and surrounded with knobby plaits. Stalk very short, inserted in a shallow, evenly rounded cavity. Skin green, marked with some rusty spots next the sun. Flesh greenish yellow, firm, moderately juicy, with a brisk acidity.

A good kitchen apple, valuable for its long and sound keeping, fit for use from January till June.

The tree is an excellent bearer, hardy, and well adapted for northern climates.

72. **HAWTHORNDEN**—syn. Hawthorndean, Red Hawthornden, White Hawthornden.—*Shoots* strong, of a light chestnut colour, sprinkled with white spots, rather downy. *Leaves* large, oval or roundish oblong, acuminate, regularly serrated. Petioles long. *Flowers* middle-sized. Petals roundish ovate, of a bright rose colour. *Fruit* in general large, sometimes very large, roundish, flattened at both ends, with sometimes a broad prominent rib extending from the base to the apex. Eye small, closed, rather deeply set in an irregular basin. Stalk very short, thick, frequently thickened at its insertion, which is in a deep but wide-spreading cavity. Skin smooth, pale greenish yellow, tinged with bright red next the sun when well exposed. Flesh white, firm, and crisp, with an abundance of acid juice.

A most excellent apple for culinary purposes; in use from October till the end of December.

The tree is very hardy, vigorous, and an early and most abundant bearer.

73. **KENTISH CODLIN.**—*Shoots* moderately strong, erect, of a dull chestnut brown, with scarcely any dots, rather downy at the extremities. *Leaves* rather large, broad oval, acuminate, sharply serrated. Petioles rather long. *Fruit* large, conical. Eye close, placed moderately deep in a plaited cavity. Stalk very short, deeply inserted. Skin smooth, greenish yellow. Flesh white, tender, juicy, sub-acid.

A good kitchen apple, in season in August and September.

The tree is a good bearer.

74. **KENTISH FILL-BASKET**—syn. Lady de Grey's, Potter's Large, Kentish Pippin of some.—*Shoots* vigorous, chestnut-coloured, tinged with violet, profusely spotted, slightly downy. *Leaves* very large, broad oval, somewhat cordate, acuminate, doubly, rather sharply, but not deeply serrated. Petioles about 1 inch in length. *Fruit* large, roundish, somewhat irregu-

larly shaped, obtusely angular on the sides. Eye large, closed, rather deeply placed, surrounded by plaits. Stalk very short and thick, placed in a wide cavity. Skin smooth, yellowish green on the shaded side, tinged with reddish brown, and marked with rusty spots next the sun. Flesh pale yellowish green, firm, and tender, with a brisk, sub-acid juice.

An excellent kitchen apple; in season during November, December, and January.

The tree is vigorous, and a good bearer. Its leaves are remarkably large.

75. KESWICK CODLIN.—*Shoots* long and vigorous, light brown near the base, tinged with violet, towards the extremities sprinkled with numerous gray dots, moderately downy. *Leaves* middle-sized, oval, acuminate, finely serrated. Petioles about 1 inch in length. *Fruit* large, conical, obtusely angular on the sides, the angles very prominent towards the apex. Eye nearly closed, deeply sunk in an angular cavity. Stalk short, thick, obliquely inserted in a deep cavity. Skin greenish yellow on the shaded side, of a brighter yellow next the sun, sprinkled with numerous, small, dark green spots. Flesh yellowish white, and crisp, with an abundance of brisk, rather acid juice.

A very good kitchen apple, valuable on account of its earliness. It may be used in a young state as early as the middle of July, but only in perfection in August and September.

The tree is hardy, and bears abundantly, and at an early age.

76. LONDON PIPPIN—syn. Five-crown Pippin, Five-crowned Pippin, New London Pippin, White Pippin of York.—*Shoots* moderately strong, of a dull chestnut colour, thinly sprinkled with pale gray spots, very downy. *Leaves* middle-sized, roundish oblong, somewhat acuminate, obtusely crenated. Petioles short. *Fruit* middle-sized or rather large, roundish, somewhat depressed, broadest at the base, with several ribs, the five principal becoming more prominent as they approach the eye, where they terminate in an equal number of ridges. Eye large, open, inserted in a shallow cavity. Stalk moderately long, rather slender, deeply inserted. Skin smooth, shining, deep brownish red next the sun, gradually fading away towards the shaded side, which is of a fine pale lemon colour when the fruit is perfectly ripened. Flesh yellowish white, firm, crisp, with an abundance of brisk juice.

An excellent kitchen apple, which keeps

well and does not shrivel. It is in use from November till April, and, when mellowed by keeping, may also be eaten at the dessert.

The tree is a moderate bearer, somewhat inclined to canker in some soils. The Newtown Pippin, grown under favourable circumstances in this country, bears more resemblance to this fruit than to any other.

77. MANKS CODLIN—syn. Frith Pitcher, Irish Codlin, Irish Pitcher, Eve Apple of Scotland.—*Shoots* of medium length, chestnut-coloured, tinged with violet, thickly covered with down towards the extremities, where there are scarcely any dots, and but few near the base. *Leaves* middle-sized or rather large, oval, somewhat cordate and acuminate, doubly, rather sharply, but not deeply serrated. Petioles scarcely 1 inch in length. *Fruit* middle-sized, conical. Eye small, deeply set in a small plaited cavity. Stalk rather short, in general obliquely inserted, the base of the fruit projecting on one side. Skin glossy, of a fine pale yellow, set with numerous, small, greenish white spots, with a fine clear blush of red next the sun. Flesh white and firm, with a brisk and pleasant sub-acid juice.

An excellent kitchen apple; in season from the beginning of August to October or later.

The tree is hardy, and a good bearer.

78. MERÈ DE MENAGÉ—syn. Haus Mutterchen, Riesenapfel, German Spa.—*Shoots* vigorous, olive brown near the base, brownish violet towards the extremities, sprinkled with small round gray dots, and rather downy. *Leaves* large, roundish, cordate at the base, shortly and abruptly acuminate, entire at the base, slightly serrated elsewhere. Petioles short and thick. *Fruit* very large, irregularly round. Eye very large, open, with the segments of the calyx converging. Stalk very short, inserted in a wide cavity. Skin, for the most part, deep dark red, greenish brown, faintly tinged with red where shaded, the whole covered with a fine bloom like that of a plum. Flesh greenish white, and very firm, with a refreshing, sub-acid juice.

A first-rate kitchen apple; in use throughout the winter and spring.

The tree is a very free grower and a great bearer.

79. MONSTROUS LEADINGTON—syn. Green Codlin.—*Shoots* very vigorous, dull brown, very downy. *Leaves* broad oval, acuminate, coarsely serrated. Petioles of medium length, strong. *Fruit* very large, oblong, flattened,

and nearly of equal width at both ends, ribbed on the sides. Eye very large, deeply set in a moderately wide, deep cavity, the sides of which are plaited. Stalk short, thick, not deeply inserted. Skin smooth, green, tinged with brownish red next the sun, slightly mottled with white near the base. Flesh greenish white, soft, and rich, with a brisk, acid juice.

An excellent kitchen apple; in use from October to January.

The tree is hardy, and a tolerably good bearer.

80. NELSON CODLIN — syn. Nelson Apple, Backhouse's Lord Nelson.—*Shoots* long, rather slender, chestnut brown, marked with a few small spots, rather downy. *Leaves* middle-sized, oval, somewhat cordate at the base, acuminate, doubly, sharply, but not deeply serrated. Petioles slender, upwards of 1 inch in length. *Fruit* large, conical or oblong, slightly angular on the sides. Eye small, closed, deeply placed in a confined, plaited basin. Stalk very short, slender, deeply inserted in an angular cavity, beyond the mouth of which it does not protrude. Skin greenish yellow, sprinkled with green specks on the shaded side, deep brownish yellow next the sun. Flesh yellowish, soft, sweet, and juicy, with a pleasant, slightly aromatic flavour.

An excellent kitchen apple, which is also useful for the dessert; in season from September to January.

The tree is hardy, a most abundant bearer, and suitable for northern climates.

81. NONESUCH. — *Shoots* tolerably strong, dark chestnut, sprinkled with a few small spots, moderately downy. *Leaves* middle-sized, oblong, somewhat cordate at the base, acuminate, slightly serrated. Petioles short. *Fruit* middle-sized, oblate, with a regular outline. Eye large, nearly closed, placed in a shallow, even depression. Stalk short, slender, in a medium-sized, evenly rounded cavity. Skin smooth, pale green on the shaded side, yellow next the sun, marked all over with broken streaks of red. Flesh white, soft, with an abundance of pleasant, sharp juice.

An excellent kitchen apple, which, from falling well in cooking, is much esteemed for sauce. It is also well adapted for making apple jelly. In season during September and October.

The tree is an abundant bearer, producing fruit at an early age; but, when old, apt to

canker in some soils. It should, nevertheless, be in every collection that is not too limited.

82. NORFOLK BEAUFIN—syn. Norfolk Bee-fin, Norfolk Beefing, Catshead Beaufin, Read's Baker.—*Shoots* moderately vigorous, chestnut-coloured, moderately sprinkled with yellowish brown dots, rather downy. *Leaves* large, roundish oval, somewhat cordate at the base, acuminate, flat or convex, sharply serrated. Petioles about $\frac{1}{10}$ ths of an inch in length. *Fruit* middle-sized, oblate, obtusely angular on the sides. Eye large, open, placed in a rather deep, plaited cavity. Stalk short, deeply inserted. Skin dull dark red next the sun, changing to a pale copper colour towards the shaded side, where the ground colour of green breaks through in places. Flesh greenish white, very firm, rather dry, acid, and somewhat astringent.

A good kitchen apple; in season from January to June, and considered superior to every other for drying. When dried and flattened it constitutes the *beefins* of the shops.

The tree is a good bearer, but requires a good warm soil, otherwise it is apt to canker.

83. NORTHERN GREENING — syn. Walmer Court, John Apple of some.—*Shoots* long and vigorous, of a dark chestnut colour, sprinkled with very numerous whitish dots, moderately downy. *Leaves* large, oval, somewhat acuminate, sharply serrated. Petioles of medium length. *Fruit* middle-sized or rather large, oval or ovate, with a regular outline. Eye small, closed, set in a small, shallow basin, and surrounded by some small, knobby plaits. Stalk short, frequently inserted obliquely, the base of the fruit forming a projecting curve on one side. Skin very smooth, green where shaded, becoming yellowish green by keeping, tinged with brownish red next the sun. Flesh greenish white, crisp, and very juicy, with a sharp, brisk flavour.

An excellent, sound-keeping kitchen apple; in season from November till April. It is one of those apples that are not apt to shrivel.

The tree is vigorous, hardy, and a good bearer. Its shoots are marked with a greater number of spots than those of any other apple.

84. REINETTE BLANCHE D'ESPAGNE — syn. Reinette d'Espagne, Camuesar, Fall Pippin, Cobbett's Fall Pippin, Large Fall Pippin, White Spanish Reinette.—*Shoots* long, of a dark chestnut colour, tinged with violet, and thinly strewed with whitish spots, moderately downy. Petioles long and strong. *Fruit* of

the largest size, roundish oblong, flattened at both ends, slightly angular on the sides. Eye large, open, very deeply sunk in a wide angular cavity. Stalk generally short, moderately thick, set in a narrow, evenly formed hollow. Skin smooth, yellowish green on the shaded side, brownish red next the sun, the whole sprinkled with small, blackish dots. Flesh yellowish white, tender, juicy, rich, and sweet, with an agreeable acidity.

An excellent kitchen apple, which is also very good for the dessert; in season from November to March.

The tree is subject to canker in this country, and therefore should not be planted in orchards; but, on account of the extraordinary size of the fruit, one or more trees of it may be grown as dwarfs.

85. ROUND WINTER NONESUCH. — *Shoots* strong, olive brown, with few spots, very downy. *Leaves* large, concave, reflexed, cordate, acuminate, irregularly serrated. Petioles remarkably short, about $\frac{1}{10}$ ths of an inch in length. *Fruit* large, roundish. Eye small, not deeply sunk. Stalk short, thick, not deeply inserted. Skin yellowish green where shaded, streaked with shades of dull and deep red on the side next the sun. Flesh white, firm, juicy, and rather acid.

A good kitchen apple; in season from November to March.

The tree is vigorous and a great bearer.

86. ROYAL RUSSET — syn. Leathercoat, Passe-pomme du Canada, Reinette du Canada Grise, Reinette du Canada Platte. — *Shoots* strong, spreading, of a reddish chesnut colour, thinly strewn with light brown dots, very downy. *Leaves* middle-sized, ovate, acuminate, obtusely serrated. Petioles short and thick. *Flowers* large, forming dense umbels. Petals broad, roundish, cordate at the base. *Fruit* large, obtusely conical, flattened at the base, obtusely angular on the sides. Eye closed, placed in a narrow, rather deep cavity, the sides of which are plaited. Stalk very short, thick, inserted in a wide, deep hollow. Skin covered with russet, which is brown on the shaded side, reddish next the sun; the whole surface strewn with small whitish and pale brown spots. Flesh greenish white, tinged with yellow, firm at first, but apt to become elastic, with a brisk, somewhat aromatic, acid juice.

An excellent, long-keeping kitchen apple; in use from November till May or June. It

should be preserved in dry clean sand, otherwise it is apt, like all the russets, to become tough.

The tree bears abundantly, but, as Mr. Ronalds observes in his *Pyrus Malus Brentfordiensis*, it is apt to canker if not in loamy rich soil. It, however, deserves attention; for many prefer russets for kitchen use, and this in particular, on account of the large size of the fruit. The size of the flowers is a character by which this variety may be readily distinguished from other russets.

87. RYMER — syn. Caldwell, Green Cossings, Newbold's Admiral Duncan, Newbold's Duke of York. — *Shoots* strong, short-jointed, of a chestnut colour tinged with violet, sprinkled with numerous gray specks, rather downy. *Leaves* large, thick, roundish oval, acuminate, doubly but not very deeply serrated. Petioles scarcely 1 inch in length. *Fruit* large, roundish, broad at the top. Eye very large, open, placed in a wide, deep hollow. Stalk very short, scarcely, if at all, sunk at its insertion. Skin smooth, clear pale green where shaded, tinged with brownish red, and streaked with brighter red next the sun; the base marked with pearly specks appearing as if in or beneath the skin. Flesh greenish white, firm, and acid.

A good kitchen apple, not apt to shrivel; in use from December till April, and even then retaining its briskness.

The tree is vigorous and an extraordinary bearer.

88. STRIPED BEAUFIN — syn. Striped Beefing. — *Shoots* moderately strong, of a dark chestnut colour, rather downy. *Leaves* large, oval, somewhat cordate at the base, doubly serrated. Petioles of medium length. *Fruit* very large, roundish, flattened a little at both ends, and having a tolerably regular outline. Eye large, open, set in a wide, deep, angular cavity. Stalk short, deeply inserted. Skin bright green, marked nearly all round with broken streaks of red. Flesh yellowish white, firm, with a brisk, agreeably acid juice.

A valuable kitchen apple; in season from October till May.

The tree is very hardy, and a good bearer.

The variety was first brought into notice by Mr. George Lindley, who, in 1794, found it growing in a garden at Lakenham, near Norwich; but its extensive distribution is due to Mr. Hogg.

89. SWEENY NONPAREIL. — *Shoots* erect,

rather slender, of a dark chestnut colour, strewed with numerous small, obscure dots, slightly downy. *Leaves* small, oval, rather sharply but not deeply serrated. *Petioles* slender, 1 inch or more in length. *Fruit* rather above the middle size, roundish, broadest at the base. Eye small, partially closed, set in a narrow, shallow cavity. Stalk short, rather slender, not deeply inserted. Skin of a deep green, always thickly set with patches of russet, and sometimes almost entirely covered with brown russet, occasionally tinged with red next the sun. Flesh greenish and tolerably firm, with an abundance of brisk, acid juice.

An excellent kitchen apple; and, late in the season, with those who prefer a sharp apple, it is considered tolerably good for the dessert, but otherwise it is too acid for that purpose. It is in season from December to April or May for kitchen use; but for dessert from February till May.

The tree is moderately vigorous, healthy, and a very abundant bearer.

The variety was raised, in 1807, by Thomas Parker, Esq., of Sweeny, in Shropshire.

90. TOWER OF GLAMMIS—syn. Glammis Castle, Late Carse of Gowrie, Gowrie.—*Shoots* vigorous, light brown, spotted with white, moderately downy. *Leaves* large, roundish, cordate at the base, acuminate, acutely crenated. *Petioles* very short. *Fruit* large, conical, and having four prominent angles extending from the base to the apex, where they form large plaits surrounding the eye. Eye large, closed, deeply sunk. Stalk short, thick, inserted in a deep cavity. Skin greenish yellow on the shaded side; yellowish brown, with sometimes a tinge of red next the sun. Flesh white, solid, and crisp, with an abundance of brisk juice.

A large heavy kitchen apple of first-rate excellence; in season from November till February.

The tree is hardy, vigorous, and a good bearer. It is much cultivated in the Carse of Gowrie and other parts of Scotland, for which climate it is well adapted; and it also succeeds well in the southern parts of the kingdom. It therefore deserves to be recommended for general cultivation.

91. WALTHAM ABBEY SEEDLING.—*Shoots* not very strong, chestnut-coloured, with few spots, slightly downy. *Leaves* small, ovate, tapering to the point, finely serrated. *Petioles* about 1 inch in length. *Fruit* large, roundish.

Eye small, partially open, set in a small, somewhat contracted hollow. Stalk short, inserted in a small, moderately deep cavity, the sides of which are lined with russet. Skin pale yellow, thickly strewed with small pale dots, and partially sprinkled and mottled with russet. Flesh yellowish, soft, sweet, moderately juicy, and of an agreeable flavour.

An excellent kitchen apple, requiring but little sugar, and particularly good for baking; in season from September to January.

The tree is vigorous, attains a large size, and is a good bearer.

92. WINTER GREENING—syn. Claremont Pippin, Easter Pippin, French Crab, Ironstone Pippin, Young's Long-keeping, Ironside in Gloucestershire.—*Shoots* long and strong, of a deep chestnut colour, sprinkled with very small dots, moderately downy. *Leaves* middle-sized, oval, concave, cordate at the base, acuminate, coarsely serrated. *Petioles* from six to nine-tenths of an inch in length. *Fruit* middle-sized, roundish. Eye small, closed, scarcely sunk, surrounded by small knobs and plaits. Stalk short, placed in a shallow, rounded cavity. Skin smooth, deep green, changing to greenish yellow on long keeping, tinged with dull red next the sun; the whole sprinkled with small dark spots, and occasionally with some rust-coloured specks. Flesh greenish, very firm, with a brisk, pleasant, acid juice.

A very good kitchen apple, useful also late in the season for the dessert, and valuable for its long keeping, frequently remaining sound for more than a year.

The tree is vigorous, hardy, and a good bearer.

93. YORKSHIRE GREENING—syn. Coates', Yorkshire Goose-sauce, Seek-no-further of some.—*Shoots* strong, dark violet, tinged with olive where shaded, sprinkled with a few spots, moderately downy. *Leaves* rather large, roundish oval, tapering abruptly to a long point, doubly serrated. *Petioles* scarcely 1 inch in length, with remarkably large stipules. *Fruit* large, oblate, somewhat angular on the sides. Eye large, closed, set in a shallow cavity, the sides of which have projections formed by the terminations of the ribs. Stalk very short, thick, woolly, placed in a wide, shallow cavity, the sides of which are usually russeted. Skin dark green, obscurely streaked with red, interspersed with broken streaks and small patches of bright red next the sun. Flesh greenish

white, firm and crisp, with an abundance of brisk, acid juice.

A first-rate apple for kitchen use, and esteemed by cooks as an excellent sauce apple. It is in season from October till February.

The tree is of a spreading habit, hardy, vigorous, and a great bearer.

The following tables exhibit, in a comprehensive form, the periods during which the varieties described *generally* continue in use, and will afford considerable facilities in making selections of sorts to ripen in succession, or at any particular period. The asterisks indicate the months in which the fruit is in use.

Table exhibiting the Months in which the Dessert Apples previously described are generally in use.

NAME.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.
Adams' Pearmain,.....	*	*	*	*
Autumn Pearmain,.....	*	*
Barcelona Pearmain,.....	*	*	*
Baxter's Pearmain,.....	*	*	*	*
Beaehamwell,	*	*	*	*
Blenheim Pippin,.....	*	*	*	*
Boston Russet,.....	*	*	*
Braddick's Nonpareil,.....	*	*	*	*
Brickley Seedling,	*	*	*	*
Cambusnethan Pippin,.....	*	*	*	*
Claygate Pearmain,.....	*	*	*	*	*
Cockle Pippin,.....	*	*	*	*
Coe's Golden Drop,.....	*	*	*	*	*	...
Cornish Aromatic,.....	*	*	*	*
Cornish Gilliflower,.....	*	*	*	*	*	*	...
Court of Wick,.....	*	*	*	*	*	*	*	*	...
Court-pendû Plat,.....	*	*	*	*	*
Devonshire Quarrenden,.....	...	*
Dutch Mignonne,.....	*	*	*	*	*
Early Harvest,.....	...	*	*	*	*	*
Early Nonpareil,.....	*	*	*
Early Red Margaret,.....	...	*
Fearn's Pippin,.....	*	*	*	*
Golden Harvey,	*	*	*	*	*	*	...
Golden Pippin,.....	*	*	*	*	*	*
Golden Reinette,.....	*	*	*	*
Herfordshire Pearmain,.....	*	*	*	*	*
Hubbard's Pearmain,.....	*	*	*	*	*	*
Hughes' Golden Pippin,	*	*	*	*	*
Irish Peach Apple,.....	*	*	*	*
Kerry Pippin,.....	...	*	*
King of the Pippins,	*	*
Lamb Abbey Pearmain,.....	*	*	*
Margil,	*	*	*	*
New Rock Pippin,.....	*	*	*	*	*	*	...
Newtown Pippin,.....	*	*	*	*	*	...
Old Nonpareil,.....	*	*	*	*	*	...
Ord's Apple,.....	*	*	*	*	*	...
Oslin,	*	*
Pearson's Plate,.....	*	*	*	*
Pitmaston Golden Harvey,	*	*	*	*	*	...
Pitmaston Golden Pippin,	*	*	*
Pitmaston Nonpareil,.....	*	*	*
Pitmaston Pine Apple,.....	*	*
Red Astrachan,.....	...	*	*
Reinette du Canada,.....	*	*	*	*	*	*
Reinette de Laak,	*
Ribston Pippin,.....	*	*	*	*	*
Sam Young,.....	*	*	*	*
Searlet Crofton,.....	*	*	*
Scarlet Nonpareil,.....	*	*	*
Scarlet Pearmain,.....	*	*	*	*
Sturmer Pippin,.....	*	*	*	*	*
Summer Golden Pippin,.....	...	*	*
Summer Thorle,.....	...	*	*
Syke House Russet,.....	*	*	*	*
White Astrachan,.....	...	*	*
White Juneating,.....	*	*
Wormsley Pippin,.....	*	*

Table exhibiting the Months in which the Kitchen Apples previously described are generally in use.

NAME.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.
Alexander,.....	*	*	*	*
Alfriston,	*	*	*	*	*	*
Beauty of Kent,	*	*	*	*	*
Bedfordshire Foundling,.....	*	*	*	*	*
Burr Knot,.....	*	*	*	*
Carlisle Codlin,.....	...	*	*	*	*	*
Dumelow's Seedling,	*	*	*	*	*
Dutch Codlin,.....	...	*	*
Gloria Mundi.....	*	*	*
Golden Noble,.....	*	*	*	*	*
Gravenstein,.....	*	*	*	*
Green Apple,.....	*	*	*	*	*	*
Hawthornden,.....	*	*	*
Kentish Codlin,.....	...	*	*
Kentish Fill-Basket,.....	*	*	*
Keswick Codlin,.....	...	*	*
London Pippin,	*	*	*	*	*	*
Mauks Codlin,.....	...	*	*	*
Mère de Ménage,	*	*	*	*
Monstrous Leadington,.....	*	*	*	*
Nelson Codlin,.....	*	*
Nonesuch,.....	*
Norfolk Beaufin,.....	*	*	*	*	*	*
Northern Greening,.....	*	*	*	*	*	*
Reinette Blanche d'Espagne,	*	*	*	*	*
Round Winter Nonesuch,.....	*	*	*	*	*
Royal Russet,	*	*	*	*	*	*	*	...
Rymer,.....	*	*	*	*	*
Striped Beaufin,.....	*	*	*	*	*	*	*	*	...
Sweeny Nonpareil,.....	*	*	*	*
Tower of Glammis,	*	*	*	*
Waltham Abbey Seedling,.....	*	*	*	*
Winter Greening,.....	*	*	*	*	*	*	*	*	*	*	*	*
Yorkshire Greening,.....	*	*	*	*
<i>Dessert Apples which are also suitable for Culinary Purposes.</i>												
Autumn Pearmain,.....	*	*
Baxter's Pearmain,.....	*	*	*
Blenheim Pippin,.....	*	*	*	*
Dutch Mignonne,.....	*	*	*	*	*
Fearn's Pippin,	*	*	*	*
Herefordshire Pearmain,.....	*	*	*	*
Reinette du Canada,.....	*	*	*	*	*	*
Ribston Pippin,.....	*	*	*	*
Sturmer Pippin,	*	*	*	*	*	*
Wormsley Pippin,.....	*	*

In addition to the varieties already described, the following may also be briefly adverted to:—

DESSERT.

ASHMEAD'S KERNEL.—Fruit rather small, roundish, flattened, yellow and russet; flesh juicy, rich, and sugary. Season, from December to May.

API PETIT (Lady Apple of the Americans).—Fruit small, oblate, pale yellow, of a glossy bright red next the sun; flesh white, juicy, perfumed. Season, October to April. The tree is subject to canker. The fruit is imported from America for the London market. Its beauty is its chief recommendation.

AUGUSTUS PEARMAN.—Fruit very hand-

some, middle-sized, pearmain-shaped, greenish yellow and bright red; juicy and pleasant. Season, November and December. The tree is an abundant bearer.

BETSEY.—Fruit small, roundish or flatly conical, pale yellow, with slight russet; flesh greenish yellow, juicy, and exceedingly rich. Season, from November to January.

BOROVITSKY.—Fruit middle-sized, pale green and bright red, streaked; flesh white, juicy, and sugary. Ripe in the middle of August.

BORSBORFFER.—Fruit small, oblate, yellow on the shaded side, red next the sun; flesh white, perfumed, only moderately good in this country. The fruit is as much esteemed in Germany as the Golden Pippin is in England. Season, from November till March.

CALVILLE BLANCHE D'HIVER.—Fruit large, roundish, with prominent ribs, white or pale yellow, sometimes slightly tinged with red; flesh white, tender, rich, and pleasant, but requiring a warm climate. Season, from January till April. Useful also for culinary purposes.

DOWNTON.—Fruit small, round, flattened at the ends, lemon yellow; flesh crisp, juicy, rather acid. Season, November till January. It is only preferred by those who like a sharp, brisk apple. The tree is an abundant bearer.

DOWNTON NONPAREIL.—Fruit middle-sized, oblate, russeted; flesh greenish white, with a rich, rather sharp juice. Season, from January till April. The tree is an abundant bearer.

DUCHIESS OF OLDENBURG.—Fruit large, handsome, round or oblate, pale greenish yellow, with red and bright crimson streaks next the sun; flesh crisp, tender, and pleasant. Season, September.

FRANKLIN'S GOLDEN PIPPIN.—Fruit small, approaching the middle size, oval, flattened at the ends, yellow, with brown spots; flesh crisp, juicy, and tender, rather sharp in ordinary seasons. Season, October to December. A good bearer.

MALE CARLE, or Charles's Apple.—Fruit middle-sized, roundish ovate, greenish yellow, with a deep crimson blush next the sun; flesh greenish white, fine, tender, and sweet, with a rose perfume. Season, November till March. Tree vigorous, shoots bright chestnut. A good bearer. It is of Italian origin, and cannot be grown to full perfection in an English climate.

MANNINGTON'S PEARMAN.—Fruit middle-sized, short pearmain-shaped, yellow, thinly russeted, tinged with brownish red next the sun; flesh yellow, crisp, juicy, and sugary, with a brisk, rich flavour. Season, from November till March.

PENNINGTON'S SEEDLING.—Fruit middle-sized, oblate, yellowish brown and rich russet; flesh yellow, rich, and sugary, but rather deficient in juiciness. Season, from November till March. A good bearer. It is useful both as a dessert and kitchen apple.

POMME DE NEIGE.—Fruit middle-sized, roundish, glossy, pale green where shaded, deep red next the sun; flesh remarkably white, tender, sweet, and pleasant. Season, November till January.

POMME ROYALE.—Fruit middle-sized, roundish, rather broadest at the base, entirely covered with russet; flesh yellowish, rich, and sugary. Season, from January till March. It

is an excellent table russet, and valuable for its sound keeping; it is also suitable for culinary purposes. The tree is a good bearer, and the variety deserving of cultivation.

RAVELSTON PIPPIN.—Fruit middle-sized, roundish, yellowish green, streaked with red next the sun, distinctly marked with pale russet spots; flesh yellowish, sweet, and pleasant. Season, August.

SCREVEYTON GOLDEN PIPPIN.—Fruit small, but somewhat larger than the old Golden Pippin, which it much resembles in form, but its skin is more russeted; flesh yellow, sugary, and rich. Season, from November till April.

UELLNER'S GOLD REINETTE.—Fruit small, oval, yellow where shaded, rich russet and red next the sun; flesh yellowish, firm, juicy, and sugary. Season, from January till May.

WHITE PARADISE—syn. Paradise Pippin.—Fruit middle-sized, ovate oblong, smooth, yellow, slightly streaked with red; flesh yellowish, crisp, juicy, and pleasant. Season, from October till December. The tree is hardy, and a good bearer; it is well adapted for northern situations.

WYKEN PIPPIN.—Fruit small, oblate, brownish yellow and dull orange; flesh greenish yellow, tender, and rich, though not equal to the Court of Wick and some others. The tree is a good bearer, and is much cultivated in the midland counties.

KITCHEN.

BRABANT BELLEFLEUR.—Fruit very large, roundish, finely coloured and streaked in a hot year, but unsuited for cold seasons and situations. Season, from November till April.

CELLINI.—A handsome apple, resembling the Nonesuch in appearance and flavour, and the tree seems more vigorous.

LUCOMBE'S SEEDLING.—Fruit large, roundish, streaked, firm, juicy. Season, from October to February. The tree is an abundant bearer.

OLD ENGLISH CODLIN.—Fruit middle-sized, conical, broad at the base; skin pale yellow, with a faint brown blush next the sun. A good sauce apple; in season from August till October. The tree is a moderate bearer.

RHODE ISLAND GREENING.—Fruit large, roundish, green; flesh yellowish green, crisp, juicy, brisk, and rich in a good season; and it may then be used either as a kitchen or dessert apple. Season, December to April. The tree is vigorous and a good bearer.

WADIHURST PIPPIN.—Fruit large, roundish oblong, tapering a little to the eye, yellowish brown, tinged with red; flesh yellowish, crisp, juicy, and brisk. Season, October to February. The tree is hardy and a good bearer.

List of Sorts adapted for Espalier Training.

DESSERT.

Adams' Pearmain.	Herefordshire Pearmain.
Barcelona Pearmain.	King of the Pippins.
Blenheim Pippin.	Old Nonpareil.
Boston Russet.	Pearson's Plate.
Claygate Pearmain.	Pitmaston Nonpareil.
Court of Wick.	Red Astrachan.
Court-pendû Plat.	Reinette du Canada.
Dutch Mignonne.	Ribston Pippin.
Early Harvest.	Scarlet Nonpareil.
Early Nonpareil.	Sturmer Pippin.
Golden Reinette.	Wormsley Pippin.

KITCHEN.

Alexander.	Hawthornden.
Beauty of Kent.	Mère de Ménéage.
Dumelow's Seedling.	Tower of Glammis.
Golden Noble.	Waltham Abbey Seedling.

Selection of Sorts for a Cottage Garden.

DESSERT.

*Baxter's Pearmain.	Scarlet Nonpareil.
*Blenheim Pippin.	*Sturmer Pippin.
*Ribston Pippin.	*Wormsley Pippin.

KITCHEN.

Dumelow's Seedling.	Tower of Glammis.
Mère de Ménéage.	Waltham Abbey Seedling.

Selection of Twelve Dessert and Six Kitchen Apples.

DESSERT.

*Blenheim Pippin.	Pearson's Plate.
Boston Russet.	Pitmaston Nonpareil.
Court of Wick.	*Ribston Pippin.
Devonshire Quarrenden.	Scarlet Nonpareil.
Golden Reinette.	*Sturmer Pippin.
Old Nonpareil.	*Wormsley Pippin.

KITCHEN.

Dumelow's Seedling.	Rymer.
Golden Noble.	Tower of Glammis.
Hawthornden.	Waltham Abbey Seedling.

Selection of Twenty Dessert and Twelve Kitchen Apples.

DESSERT.

Adams' Pearmain.	Golden Reinette.
*Blenheim Pippin.	King of the Pippins.
Boston Russet.	Old Nonpareil.
Claygate Pearmain.	Pearson's Plate.
Court-pendû Plat.	Pitmaston Nonpareil.
Court of Wick.	*Reinette du Canada.
Devonshire Quarrenden.	*Ribston Pippin.
Early Harvest.	Scarlet Nonpareil.
Early Nonpareil.	*Sturmer Pippin.
Golden Harvey.	*Wormsley Pippin.

KITCHEN.

Alfriston.	Dutch Codlin.
Bedfordshire Foundling.	Golden Noble.
Dumelow's Seedling.	Hawthornden.

Mère de Ménéage.
Rymer.
Tower of Glammis.

Waltham Abbey Seedling.
Winter Greening.
Yorkshire Greening.

Selection of Thirty Dessert Apples.

Adams' Pearmain.	Golden Reinette.
Beachamwell.	Kerry Pippin.
*Blenheim Pippin.	King of the Pippins.
Boston Russet.	Old Nonpareil.
Braddick's Nonpareil.	Ord's Apple.
Claygate Pearmain.	Pearson's Plate.
Cockle Pippin.	Pitmaston Nonpareil.
Cornish Gilliflower.	Pitmaston Pinc-apple.
Court-pendû Plat.	Red Astrachan.
Court of Wick.	*Reinette du Canada.
Devonshire Quarrenden.	*Ribston Pippin.
*Dutch Mignonne.	Scarlet Nonpareil.
Early Harvest.	*Sturmer Pippin.
Early Nonpareil.	Summer Golden Pippin.
Golden Harvey.	*Wormsley Pippin.

List of Sorts which will succeed as Standards, Dwarf Standards, or as Espaliers, in the northern parts of England and in Scotland.

DESSERT.

Adams' Pearmain.	Irish Peach.
Baxter's Pearmain.	Kerry Pippin.
Blenheim Pippin.	King of the Pippins.
Boston Russet.	Lamb Abbey Pearmain.
Braddick's Nonpareil.	Margil.
Cambusnethan Pippin.	Oslin.
Claygate Pearmain.	Pitmaston Nonpareil.
Cockle Pippin.	Ravelston Pippin.
Cornish Aromatic.	Red Astrachan.
Court of Wick.	Ribston Pippin.
Devonshire Quarrenden.	Scarlet Crofton.
Dutch Mignonne.	Scarlet Nonpareil.
Early Harvest.	Sturmer Pippin.
Early Red Margaret.	Summer Golden Pippin.
Early Nonpareil.	Summer Thorle.
Golden Reinette.	White Astrachan.
Herefordshire Pearmain.	White Paradise.
Hughes' Golden Pippin.	Wormsley Pippin.

KITCHEN.

Alexander.	Nelson Codlin.
Alfriston.	Nonesuch.
Bedfordshire Foundling.	Northern Greening.
Carlisle Codlin.	Round Winter Nonesuch.
Dutch Codlin.	Rymer.
Dumelow's Seedling.	Striped Beaufin.
Golden Noble.	Sweeny Nonpareil.
Hawthornden.	Tower of Glammis.
Keswick Codlin.	Waltham Abbey Seedling.
Manks Codlin.	Yorkshire Greening.
Mère de Ménéage.	

List of Sorts which deserve a Wall in the northern parts of England and in Scotland.

Adams' Pearmain.	Golden Reinette.
Blenheim Pippin.	Old Nonpareil.
Boston Russet.	Pearson's Plate.
Court of Wick.	Pitmaston Nonpareil.
Court-pendû Plat.	Reinette du Canada.
Early Nonpareil.	Ribston Pippin.
Golden Harvey.	Scarlet Nonpareil.
Golden Pippin.	

* Those marked * are also suitable for culinary purposes.

List of Cider Apples.

	Sp. Grav.
Bennet,	1073
Best Bache,	1073
Cocagee,	—
Cowarne Red,	1069
Devonshire Red Streak,	—
Devonshire Wilding,	—
Downton Pippin,	1080
Forest Styre,	1076 1081
Foxley,	1080
Fox Whelp,	1076-1080
Friar,	1073
Garter,	1066
Golden Harvey,	1085
Golden Pippin,	1078
Grange,	1079
Hagloe Crab,	1081
Herefordshire Red Streak,	1079
Hogshead,	—
Kingston Black,	—
New Woodcock,	—
Pawsan,	1076
Red Must,	1064
Red Norman,	—
Red Styre,	—
Royal Wilding,	—
Siberian Bitter Sweet,	1091
Siberian Harvey,	1091
Woodcock,	1073

Propagation.—The apple may be propagated by seeds, cuttings, suckers, layering, grafting, budding, and inarching.

Seeds obtained from the pomace of cider apples produce vigorous plants, suitable as stocks for orchard trees with tall stems. Seeds picked out from the cores of good table or kitchen apples are frequently sown by individuals with the view of raising new varieties, and occasionally that object is attained. In Normandy, where apples are extensively cultivated, the pomace is taken and rubbed between the hands in a vessel of water, in order to separate the pulp from the pips. After allowing some time for settling, a part of the contents of the vessel is poured off so as to get clear of the pomace and bad seeds, the pips at the bottom being the only ones that should be made use of. These are dried and kept in a dry place till they are sown. The sowing is then performed as soon as the hard frosts are over, for the seed of the apple does not long preserve its germinative powers. The ground should be well prepared, finely pulverized, and enriched with decayed manure. Drills are made 1 inch deep, and from 7 to 9 inches apart, and in these the seeds are deposited, then covered with fine soil, and afterwards rolled or pressed close with the back of the spade. It is sometimes advisable to mulch

the surface, to prevent it from becoming too dry. When the plants are 1 or 2 inches high, they are thinned out in rainy weather; otherwise the seed-beds should be watered, to settle the earth about the roots of the plants left. In thinning, care should be taken to leave the strongest plants. The ground must be kept stirred and clear of weeds during the growing season.

When a year old the plants are selected for transplanting. Stout plants are preferred to tall ones. In light soils transplanting takes place in November, but in strong ones in February or March. The plants are put in at from 20 to 24 inches apart, in rows distant from each other 40 inches. In light soils the rows are made to run east and west, but in cold soils north and south, in order that the rays of the noon-day sun may penetrate between them and warm the ground. The stem is not shortened in the same year in which transplantation takes place, unless it is very tall and slender, and then the third, or one-half at the utmost, is cut off; but at the same time a sufficient number of buds is left to produce plenty of leaves, for these encourage the tree to take root by elaborating sap for the production of numerous small roots.

If it is intended to graft the trees standard high, the upward growth of plants that are inclined to grow straight should be encouraged by pinching the young shoots on the sides, in order to divert the sap into the terminal shoot; and such plants as are crooked ought to be cut down to obtain a vigorous upright shoot.

The shoots on the young stem should be preserved until it has attained a sufficient size to be grafted, but they must not be allowed to grow too large. They ought to be shortened to 8 inches or 1 foot in the beginning of June, earlier or later according to the season. The stubs or shortened shoots left on the stem should not be cut off at once, but partial removals should be annually made in autumn, or before the sap rises in spring. They should be removed by an upright cut, at about one-tenth of an inch from the stem, and parallel to the circular wrinkles or rings at the base of the shoot, for if cut off in the direction of these the wound soon heals over.

The above are the essentials of what is considered, in Normandy, the best mode of raising apple trees from seed, and of rearing them with a tall stem, fit for standards. In this

country they are raised from stocks nearly in the same manner; but they are transplanted, first from the seed-bed, again when they are strong enough for bedding out, and finally when they are to be placed in nursery rows for grafting.

Propagation by cuttings is seldom resorted to with the apple, but the Burr-Knot, Codlins, and some other sorts, strike readily in warm, moist soil; and any of the varieties may be propagated in this manner with a little extra care, if circumstances should render that mode necessary, as when some sort is required to be preserved when no stocks are in readiness for budding or grafting.

Propagation by suckers is also seldom adopted. When suckers spring up they are sometimes taken advantage of for stocks; or if they come from the roots of a seedling tree, young trees of the identical variety are at once obtained. Propagated in this manner, however, the plants are apt to throw up suckers again. It will be advisable, therefore, to plant the suckers where they can grow for a year or two before they are planted where they are to remain; and on removing them for this purpose, any buds likely to push and form suckers on the underground portion of the stem ought to be cut clean out. If the sucker is at once planted in the spot which it is finally to occupy, the roots and lower part of the stem should be cleared of buds previous to planting.

Layering.—Dwarf varieties, such as the English and French Paradise, Doucin, &c., are propagated by layers for stocks for dwarfs.

Grafting.—This mode of propagation is the one most generally adopted for the multiplication of the varieties of the apple. Any of the methods detailed in the article on grafting may be employed, but of all others whip-grafting is to be preferred for the reasons stated in that article, where the process is so fully described that there remains but little to be added. It may be well, however, to remark, that the stocks should be grown in well-manured soil, so as to be healthy and vigorous, and at least as thick as the finger. They ought to be headed back to where the graft is to be placed, in January if the weather is not too severe, but in any case before vegetation becomes active. It is not advisable to cut them down in hard frost, as in that case small splits often take place at the wounded part. If the weather permit, the heading-back should not be deferred to a later period than the end of

January or beginning of February. The scions ought to be cut from the healthiest trees that can be found. Where canker is observed in any part of a tree, the apparently healthy shoots from that tree should not be taken if scions can be obtained from a healthy one.

The scions ought to be cut in January, but not when they are in a frozen state; and to preserve them till the time for grafting arrives, a spade-deep trench should be dug out from east to west, throwing the soil on the south side, so as to form a ridge, on the north side of which the cuttings should be laid in, but not in bundles, the inner portion of which would be hardly, if at all, in contact with the moist soil, and would, consequently, be apt to become dried up. Each cutting should have its side laid against the slope of the trench, and its end in contact with the soil at the bottom. The lower portion of the cutting must then be covered with soil, which may be tapered up to nearly its entire length, and pressed close. Scions may also be preserved until the time of grafting, by sticking their ends in moist sand; and they may be kept alive for a year by shortening them a little, and inserting to the depth of 5 inches in moist, shaded ground. Treated in this way, we have seen cuttings taken off in January, and grafted successfully in the March of the following year, fourteen months after their removal from the tree.

Grafting is performed at 9 inches from the ground for dwarf trees, and also for standards when the sort worked is calculated to form a good straight stem, as is the case with many of the strong-growing kitchen apples. But with regard to many of the weaker dessert sorts, it is better to select such stocks as appear likely, from their upright growth, to make good stems, and graft them at standard height. For exposed situations, where the trees are apt to be broken by the wind, there is an advantage in having the tree worked low, because if the top should be broken off, a strong shoot, pushing from some part of the stem below, can be trained up to form a fresh head. For orchard standards the crab stock is to be preferred; and also when the tree is to be subjected to some modes of dwarf-training in which long shoots are required. For gardens of limited extent, in which small standards are more appropriate than large, and generally for all dwarf trees, with the above exceptions, the Paradise stock should be chosen. For very

dwarf trees, and for those to be grown in pots, the dwarfest of all stocks, the French Paradise, may be employed.

Budding is now more practised than formerly. Finer growths are sometimes the result, and the operation may often be more conveniently performed than grafting, which has to be done when planting and other ground work has to be carried on.

Inarching is not usually practised for obtaining a new plant. It might be occasionally employed for trees in pots, as a portion of a branch with fruit-spurs might be transferred to the stock in the pot, and thus fruit could be obtained from it in the following year.

Situation.—In general, the best situation is on a slope inclining towards some point between south-east and south-west. Between south and south-west would be preferable, were it not for the strong gales which frequently come from that quarter about the time of the autumnal equinox, and which spoil much of the crop by shaking it from the trees. This evil may, however, be considerably modified by planting trees adapted for shelter in such a manner as to effectually break the force of the wind. A southern exposure is most desirable for giving richness of flavour to the fruit, yet there have been instances where tolerable crops have been obtained from apple trees planted on slopes facing the north, when the crop from those facing the south has been destroyed by frost in spring. This, however, would not compensate for the greater degree of perfection which the southern aspect would generally insure.

In choosing a situation, the climate of the locality as regards the fall of rain deserves to be taken into consideration. Trees are apt to suffer from want of moisture when the subsoil is naturally well drained, and when the fall of rain does not exceed 24 inches per annum. They do so in the valley of the Thames, where they happen to be planted in good garden soil, resting on a bed of loam, and this again on gravel affording perfect drainage. So long as the soil and loam is moist, the trees thrive exceedingly well; but as the trees increase in size, and acquire a surface of foliage capable of evaporating more rain than falls on the surface of the soil in which the roots extend, dryness at the root must be the consequence; for whilst the foliage is healthy it will act, and must evaporate when the air is not saturated with moisture, and to supply

the waste caused by this evaporation the roots will absorb all the moisture within their reach. In a short time the principal portion of the roots is in a medium as dry as dust, and in which they must remain as inert as pieces of dry sponge. The greatest dryness is found to take place in the stratum of loam, where the roots chiefly penetrate so long as moisture is to be found there, and from this, consequently, the tree chiefly derives its nourishment. Deprived of this, it can no longer thrive, and has to depend for mere existence on a few roots at the surface, where, especially if it is kept stirred, some moisture, which has been deposited during that period of the twenty-four hours when the air is considerably warmer than the soil with which it comes in contact, will always be present. With this limited supply, the tree can only linger. Vigorous shoots are no longer produced; sometimes the wood of the previous year dies back; layers of alburnum can scarcely be deposited; the numerous buds and spurs previously originated can be only partially developed; a large portion of them dies in the attempt to vegetate, and the whole tree assumes a stunted, sickly, or cankered appearance. This deplorable condition is neither owing to the variety nor the soil and aspect, but solely to the action of the roots being suspended for want of moisture. It is therefore obvious that the cause of so much evil demands serious consideration.

The lower part of slopes, and the level at their base, will generally have a subsoil moist enough at all seasons, owing to the descent of water from the higher ground. Where the amount of rain does not exceed 24 inches, such places will be found eligible for the apple, so far as moisture is concerned. For the greatest amount of heat and light, the southern exposure is to be chosen. Similar situations will answer for moister climates, provided effectual means are taken to carry off superfluous moisture.

Soil.—The apple tree will thrive in any good soil which is neither too dry nor too moist; but it lives longest, and produces the heaviest crops, where the soil is a good substantial loam; and, in all cases, the less iron there is in the subsoil the better. It succeeds very well in marly soils; and the addition of marl to soils that are not naturally calcareous improves them for the growth of the apple. In hot sandy soils the trees are apt to canker, and the extremities of their shoots to die back;

whilst in such as are too heavy, or with cold, wet subsoils, they become diseased, and are frequently overgrown with moss.

Preparation of the Ground.—To prepare the ground properly, the directions given in treating of the formation of the kitchen garden should be followed. If circumstances will not admit of their being followed out to their full extent, yet they should be kept in view, and acted upon as far as possible. If the ground requires draining, that should be seen to in the first place. It must then be well trenched, whether the plantation be of small or large extent; for, in either case, the trees will amply repay the trouble of the operation. In trenching, let the good soil be thrown up where it is deep; let all inequalities which may then appear in the bottom of the trench be reduced, and, when all is trenched over, the surface can either be levelled, or made to form a regular slope or slopes, such as may be found to agree best with its general inclination. In wet or cold subsoils, it has been recommended to plant the trees on the surface, or in raised mounds or ridges. This may succeed very well for a time, but ultimately the roots will go down after moisture, if this should, in some dry summers, be deficient near the top. It is therefore a much better plan to drain the subsoil effectually, and thus render high planting unnecessary, so far as regards too much moisture at the root. As already observed, there are, however, many situations in which the trees are liable to suffer for want of sufficient moisture at the roots. It may appear paradoxical to propose remedying this serious evil by planting on mounds or ridges—the very means by which too much moisture is frequently to be remedied. An explanation, therefore, becomes necessary; and we shall take an actual case in point. On a level garden soil, 18 inches deep, lying on an equal or greater thickness of yellow loam resting on a naturally good drainage of gravel, trees suffered after their roots had drained the loam of all apparent moisture; and the rain uniformly penetrated the surface soil, but was mostly absorbed by the latter before reaching the stratum of loam. A row of trees, in the same kind of soil and subsoil, grew luxuriantly every season. These trees were planted near the edge of a walk, in front of a south-aspect border. The soil where their roots were situated had, of course, its due share of the rain which fell over the general surface; but, in addition to this, it had that which flowed

down the slope of the border, and that of the walk. These slopes formed a sort of gathering ground; and the water thus collected proved sufficient to keep moist the subsoil in the vicinity of the trees, whereas if the border had been level, and no water had flowed from the surface of the walk, the trees would have been in the same condition as the others that had only the quantity due to the equal distribution of the amount of rain. Now, if the trees of an orchard were planted on a ridge, say about 6 inches, or from that to 1 foot above the general level of the ground, a slope could be formed on each side of the tree by digging the soil towards it to a certain extent. At first, the slope might terminate in a depression or furrow, running parallel to the row of trees, and about 4 feet from it on each side; and, as the roots extend, the distance of the furrows from the trees could be increased. In this way moisture for the extremities of the roots may be obtained. A tree cannot thrive well when the extremities of the roots are in a dry medium, even although the soil close to the stem may be moist in consequence of the tree being placed in a hollow. But reverse this: let the soil at the extremities be moist, and it matters little if it is dry near the stem. Therefore, it is advisable to supply moisture to the extremities of the roots, even if the ground in the vicinity of the stem is deprived of that supply; and, accordingly, the rows of trees may be elevated on convex ridges, with a sort of valley between, in which water may accumulate in sufficient quantity, not only to saturate occasionally the surface soil, but also to moisten throughout the stratum beneath. If the extremities of the roots can be thus supplied with water, the extremities of the shoots will never perish for want of it.

If the soil is not naturally rich enough, it should be well manured. By duly attending to this point, larger trees will be produced in ten years than would be the case in twenty years if this precaution were neglected. We do not wish to encourage over luxuriance in any case; but a healthy, vigorous growth should be promoted. If, consistent with this, a tree make annually twice the quantity of shoots and foliage that another does that is stunted of nourishment, the former will assuredly attain double the size of the latter in a given number of years, and will also be able to bear double the quantity of fruit; and although it may not be disposed to commence bearing at

so early a period, it may, notwithstanding, be induced to do so by skilful pruning.

Instead of applying manure from the farm-yard in a fresh state, it is better to form it into a compost with such kind of soil as would, by itself, prove beneficial. Turfy loam will, in all cases, be suitable. The compost should be worked in as the trenching proceeds; and it should be placed chiefly between 1 foot and 2 feet below the surface. Some good compost ought to be reserved for mixing with the soil in planting the tree.

Planting.—Before commencing this operation, it will be necessary to determine the distances between the trees, for this, of course, must vary according to circumstances and mode of cultivation.

For *wall-trees*, the average distance may be about 20 feet.

For *espaliers*, the distance of 20 feet will generally be suitable, except in the case of some strong growing kitchen sorts, for which 24 feet may be allowed.

For *dwarfs*, trained in the pyramidal form, the distance may be from 10 to 15 feet.

Standards may be planted at 25, 30, 35, or 40 feet between the rows, varying the distances between the trees in the rows according to circumstances presently to be noticed.

As a general rule, trees should be planted farther apart in rich soil than in that which is poor; and wider in a warm, moist climate, than in one that is hot and dry. Under circumstances of a moist soil, combined with heat and moisture, the trees are disposed to grow to wood rather than to bear fruit, and that disposition is increased when they have to be much cut, in order to restrain them within a limited space.

The best season for planting the apple tree is in autumn, as soon as the greater portion of the leaves has fallen. If planted whilst the greater part of the foliage is still in action the shoots are apt to shrivel, because the leaves evaporate more than the recently moved roots can supply. If, however, the autumn continue mild, the young leaves at the extremities of the shoots will remain green for a considerable time after the older ones have either dropped or become all but inactive. Whilst waiting for the falling of these leaves, the ground is cooling; and it is very desirable that the trees should be planted as long as there is still heat enough in the soil to encourage the emission of fresh roots before winter, for when such is

the case, the trees, if carefully transplanted, start in spring with scarcely any signs of removal. In order that the planting may be commenced at an early period, it will be advisable to cut off the leafy extremities of the shoots, except where the mode of training renders it necessary to retain them at full length.

If circumstances prevent the planting being executed so early as above recommended, it may be done at any time when the state of the weather permits, before vegetation becomes excited, which is often the case, in forward seasons, by the middle of February. It is therefore desirable that the planting should take place before that time. If the ground be not then ready, and from unavoidable causes the planting cannot be finished before the middle or end of March, the trees should, nevertheless, be taken up in good time before the rise of the sap, say not later than the beginning of February, weather permitting. They should be laid in a cool situation till planted out where they are intended finally to remain. If they are not kept in a cool place, buds will push, and young roots, or spongioles, will commence to form; but as these have little woody fibre in their early stage, they will be very susceptible of injury from bruising when the trees are finally planted out. This should therefore be done before young roots have begun to push from the plants which have been removed with the view of being retarded in their vegetation. It is only for this purpose that removal can be recommended to be done before the tree can be immediately planted. In all other cases, the best plan is not to take up till it can be replanted with the least possible delay.

The ground ought to be marked where the trees are to be planted; and to the places determined on some good compost should be brought, say one or more barrow-loads to each tree, according as it can be obtained, and according to the greater or less natural richness of the soil. The compost should be laid so as not to interfere with the stretching of the line, as must likewise be the soil dug out of the hole for the reception of the tree.

The holes ought to be square, wider than the length of the roots when these are extended at full length, and as wide at bottom as at top, if the nature of the soil will admit. They should be so deep as to allow of the tree being quite as much in the ground as it was before removal, and deeper at the sides than

in the middle; the bottom will thus be convex, instead of being flat or carelessly hollowed out like a basin, against the sides of which the roots are turned up, whereas they should slope gently downwards, a direction of which the convex form of the bottom will admit.

The tree should be taken up with its roots as entire as possible, but all that are unavoidably bruised ought to be cut clean off, for the bruised portions either linger and act imperfectly, or rot; in either case it is better to remove them at once, so that fresh ones may be produced instead. In planting, the roots must be disentangled and carefully and equally spread over the mound. It should be recollected, that a tree having its roots properly disposed, will resist the wind better than one with its roots twisted round each other, so that they cannot extend freely. The roots having been properly placed, fine soil, mixed with compost, ought to be introduced among them, but no rank manure should be brought in contact with them. The soil ought to be scattered in the direction of the fibres, for these would be improperly reversed by throwing the soil against that direction or towards the tree, as is frequently done.

As already remarked in the chapter on transplanting, it is better to settle the earth about the roots by a copious watering than by hard treading; therefore, when the roots are little more than just covered with soil, a good watering should be given, moving the tree gently at the same time. By this means the small cavities among the roots will be filled up by the washing in of the soil. When the water has completely subsided, which may be in a few hours, or the next day, according to the state of the weather and nature of the soil, the remaining portion of the earth dug out of the hole should be levelled up to the tree. The latter must be secured to a stake if it require such; and a mulching of litter as far as the roots extend may also be given with beneficial effects.

In planting against walls, the bottom of the hole should be highest next the wall, and sloping equally downwards towards the other three sides. It ought to be deep enough to admit of the tree being as far in the soil as it formerly was; and the tree should be placed about 9 inches from the wall, to allow the stem to thicken without danger of pressure against the brick-work.

Management of Standards.—It is highly

important that these should be reared with clean straight stems; that the stem should be self-supporting; that the head should be commenced at the proper height; and that it should be formed with regularity. We may here observe that the mode formerly adopted to obtain clean stems, was that which rendered staking necessary; and, moreover, it should be understood that a tree for which staking is absolutely necessary in its youth, will always be liable to lean and twist after it has attained a considerable size. We shall suppose that the maiden plant or young tree has been well transplanted, and that it is consequently in a vigorous state. We shall select two trees as similar as possible in every respect. We shall treat one according to a mode which has hitherto been the one too commonly practised, and the other according to that which we would recommend. It was not an unusual practice to keep the stems of standard trees well trimmed, that is to say, every shoot that appeared upon them was cut closely in till the desired height was attained. A few shoots at top were only to be seen, and a slender stem unable to keep itself upright was the consequence. This is an artificial stem, for the apple does not grow to the height of 6 or 7 feet without side branches, which bear leaves to thicken and strengthen the lower part of the stem. When the tree with the artificially formed stem is transplanted, it has, however, this advantage, that though liable to bend from feebleness, it can, from that very circumstance, be easily lashed straight to a stake, and so far some good comes out of evil; but, on the other hand, the stem will require support for years. Rather than have crooked trees, it is better to make sure of straight ones by supplying a fresh set of stakes, and by the time these become decayed, the trees, on their removal, will exhibit straight and apparently self-supporting stems; but left to their own strength to support their tops, now large enough to be acted upon with considerable effect by the wind, the stems bend, and cannot then be well straightened. All this arises from an improper use of the knife whilst the young stem is being reared.

To rear a straight substantial stem incurs little additional trouble in the first instance, and much trouble and expense is afterwards saved, and at the same time a satisfactory result is insured. It has been explained in the chapter on pruning, that roots and wood are

produced in proportion to the amount of foliage. In rearing a properly constituted stem, we must bear in mind that important fact. We cannot by any means get so much work done by a few leaves at the top of a stem as we can by ten times the number, produced partly at the top, and partly along the sides. We want thickness of stem, for, if we have that, height can easily be got in one or two seasons; but if the stem is tall and disproportionately slender, it is very difficult to render it inflexible. A slender stem, 6 or 7 feet high, and which has no leaves to thicken it, except those above that height, will increase equally along its whole length, and consequently will be almost cylindrical; and it is well known from experience that, when such is the case, it will be always apt to bend in the middle. To be self-supporting, it should be thickest at the base, as would have been the case had it not been for the injudicious use of the knife. By such, it is possible to produce a stem 6 feet in height, and everywhere about 1 inch in diameter; but, in that case, it could easily be bent like a bow with one hand. A stem may, however, be grown so as to have, for example, about the following dimensions—height, as in the other case, 6 feet; diameter at base, 3 inches; in the middle, 2 inches; and at 6 feet high, where the top begins to branch off, 1 inch; thus forming a long, tapering, frustum of a cone, a form very difficult to bend in any way. Of this fact any one may convince himself by taking a piece of willow—a much more flexible wood than the apple, and, after shaping it to the above dimensions, trying to bend it. Now, a stem that has once assumed a tapering form will retain it so long as it exists. The whole tree might be torn up by a hurricane, but the stem will not become crooked, and this is precisely the kind of stem that is wanted. We shall therefore endeavour to show how it may be obtained.

Commencing with the maiden shoot from the graft or bud, we find it, during summer, furnished with leaves from near its base to its extremity. If, at the end of the growing season, we girth the shoot at the top and successively below each leaf downwards, we shall find that every girth is greater and greater as we descend. The difference between each measurement will be greater or less according to the health, nature, and size of the leaves. In one which we have just measured, the dif-

ference is about $\frac{1}{20}$ th of an inch. Where a portion of a shoot is deprived of leaves such gradation does not take place, that part being nearly cylindrical; but if there are leaves below the naked portion, there will be a sensible difference in the increase of girth below the first of them, and so on to the base. From what has been stated, it is evident that all the leaves on the first shoot from the graft or bud should be encouraged. When the leaves drop in autumn, buds more or less prominent will be seen along the stem, and, perhaps, some may have pushed into laterals; the latter should be shortened at the autumn or winter pruning to two buds.

In the second season, the terminal bud will certainly push a fresh upright, if no accident has happened to it, as will, also, several others along the shoot, and some will remain dormant, especially those near the base, which, in vigorous shoots, are mostly buried in the mass of alburnum there accumulated from the aggregate elaborations of all the leaves above that part. The shoots that do push should be allowed to grow, taking care, however, to check any that are likely to compete with the leader. Foliage should be encouraged on the latter, and likewise on the young shoots of the previous year. With regard to the laterals on the former year's shoots, they may be allowed to grow till the end of July, and their extremities should then be pinched or cut off. The reason for allowing them to grow is in order that they may bear foliage to give additional strength to the stem below them, so that it may be rendered perfectly self-supporting. It is better to use them for this purpose than to give support by means of stakes, for, whilst the foliage of these laterals increases the thickness of the stem, it also contributes to encourage the formation of roots.

In autumn, when the growth of the second season is completed, the tree will exhibit a stem consisting of the first summer's shoot, now two years old, and, in continuation, the young shoot or leader which has just ceased growing. The laterals, stopped in July, should now be shortened back to one or two eyes, with the exception of two or three of the lowest, which should be cut close to the stem. The same mode of proceeding with regard to the side shoots on the stem should be adopted every year. As the head of the tree is in course of formation, and is producing abundance of foliage, the side shoots can be gradu-

ally dispensed with. The quantity of foliage on a young tree should every year considerably exceed that of the previous one; therefore, in gradually removing side shoots, care should be taken that the consequent diminution of foliage should bear only a small proportion to the increase made by the new branches and shoots at top. The rate of increase of these must regulate the more or less gradual removal and final clearance of the side shoots.

If the tree has been planted in rich soil, and has consequently grown vigorously, the upright leader will have attained the height of more than 6 feet. But whatever may be the intended height of clean stem, the leading shoot ought to be cut three buds above that height, which would be at about 6 feet 3 or 4 inches from the ground for a stem 6 feet high. Supposing, however, that the extremity of the shoot reached very little above the intended height of stem, the buds immediately below the cut, and which are to commence the main limbs of the tree, would be situated on the softest or almost herbaceous part of the shoot. Instead of this, it would be desirable that these limbs should originate from buds on the more substantial part of the shoot; therefore, if it happen that the shoot is not firm at the required height, it will be advisable to let it grow for another season, and then cut it over.

In the following spring, three shoots should be encouraged from the three buds just below the place where the leader was cut over. Three main branches are better than two, as regards the formation of a well-balanced head; four are too many from the same point, or so nearly from the same point that when they become large they appear to have done so; further, when more than three originate so closely together, they form between them a basin or hollow, in which water lodges to the injury of the tree.

As the shoots grow, they should receive particular attention throughout the summer, for much depends on the limbs being fairly and equally started. If left to themselves, they will rarely proceed at an equal rate of growth. The uppermost will incline to take the lead, and will endeavour to grow upright to form a stem. This tendency must, however, be strictly watched, and checked in good time. The shoot having this inclination should be made to diverge at a lower angle

than either of the others; and, on the other hand, the weakest shoot ought to be elevated the most. In short, the greatest possible equality of growth between these primary shoots must be maintained, by bringing into operation the means pointed out for effecting that object in the chapters on pruning and training. Before the growing season is over, 1 foot, at least, of the lower part of each shoot ought to be made straight, and all three should be trained equidistant, and to diverge from the stem at an angle of about 45° . When put in the proper position whilst still growing they will afterwards retain it. At the autumn or winter pruning, each of the shoots should be cut back to within 9 inches or 1 foot of their bases, observing to cut above two buds as nearly opposite to each other as possible, and pointing in the direction which it is desirable the shoots springing from them should take, that is, not inwards, but like a **Y** with its open part facing the centre of the tree. In the following season, two shoots, and no more, should be encouraged from each of the three original ones. The head will then consist of six shoots, originating six principal branches. By a little attention in summer, these can easily be kept at equal distances from each other, and also from the centre. The tree, it is presumed, being vigorous, many shoots will push from the branches formed as above directed. If these were allowed to remain till autumn, and then be cut back, many more would again push in the following spring; or, if they were cut off closely, the branches would be too naked. It will therefore be advisable to pinch them in summer, when they have pushed 6 inches, commencing with the strongest. By this process, shoots that would otherwise cause confusion can be made to assume the character of fruit-spurs, from which some of the largest and fairest fruit will be obtained. This is also the way to turn to account any strong shoot, or rather any one that would evidently become such, and which, if allowed to proceed, would occupy a position where it is not wanted. It is better to operate in summer than to allow the shoot to grow till autumn and then cut it back; and this, again, is better than permitting it to remain for some years, and form a thick branch which must then be cut out. In short, the head being fairly started with its six equidistant branches, it may be left to itself, with the exception of pinching, as above recommended, any badly placed shoot.

and checking any of the leaders that are likely to become too strong for the others.

Management of Open Dwarfs.—The distance between the trees may be from 10 to 15 feet, according to the variety and the size which the trees may be allowed to attain. In small gardens, they may be as close together as 10 feet, provided they are pinched in summer. In orchards or in open quarters, they may be in rows 15 feet apart, and the trees 10 feet in the rows; or they can be planted in the quincunx form, 15 feet between the rows one way, and about 13 feet the other.

Supposing the tree to be a maiden plant, or that which has made one season's growth from the graft or bud, it may be planted in autumn, and, if carefully transplanted, may then be headed back; if not, the extremities of the shoots must be shortened a little, and it should be allowed to grow at full freedom till next autumn, when it must be cut down to within 9 inches of the ground. The tree, having been a year established, will now be able to produce vigorous shoots, three of which should be selected, as in forming the head of a standard. During the summer, care should be taken that the three shoots make equal growths. They must be cut back at the winter pruning to between 6 and 9 inches in length, and thus, as in the case of standards, six branches will be originated. These should be allowed to grow freely during the summer, so as to be tolerably straight, and if kept equidistant, so much the better. It would be advisable to regulate these six shoots in winter, by training them to a hoop, which ought to be 6 feet in circumference, and the branches, secured at equal distances, would then be just 1 foot apart. In many cases, materials for hoops might not be at hand, and the purchase of them might be found too expensive. If so, three straight or nearly straight sticks, about 2 feet long, may be substituted. Three such lengths can be much more easily procured than a hoop 6 feet round. At $\frac{1}{2}$ inch from each end of the 2 feet sticks, cut a notch, so that a piece of bass, tied round, may not slip. Place the stick across the centre of the tree, and secure the two opposite shoots by the ties, near the end of the stick. Stretch the sticks in a similar manner between the other two pairs of opposite branches. When this is done, each branch ought to be exactly 1 foot from those next to it; if any are wider apart than that distance, let them be brought

to it. Whether a hoop or this contrivance be employed, the shoots, after being secured, should be shortened to a few inches above the hoop or place where they are 1 foot apart, in order that each of the six branches may be there subdivided into two, making twelve in all. In shortening, where the leading branch is not intended to be subdivided, observe to cut above a bud pointing away from the centre, or in the direction that the shoot forming a prolongation of the branch is wished to take. From the inclination of the branches, and favoured by the open space which they form, strong shoots from the upper sides of the inclined branches will be apt to push in the middle of the tree, where their presence would prove injurious. The means already pointed out for converting what would otherwise prove worse than useless shoots into fruit-spurs, should therefore be employed.

Dwarf Pyramids.—These occupy less space than the open dwarfs, of which we have just been treating. If not allowed to grow tall, and where the space is limited, they may be planted at 10 feet apart, or in the quincunx mode, 12 feet from tree to tree in every direction. This will require the lines running east and west to be 10 feet $4\frac{7}{10}$ inches apart, and the trees in these rows 12 feet from each other.

In order to have a well-formed tree, it is best to plant a maiden plant and merely top it. Allow it to establish itself for a year, then cut it down to about 1 foot from the ground. Train a shoot from the uppermost bud upright, and the others that may push below outwards. After the leaves have fallen, shorten the upright leading shoots to 15 inches above where it was cut in the preceding year. Proceed thus every year till the tree attains the desired height. This may properly be 6 feet, or from that to 12 feet, according to their distance from other things that would be injured by their shade. Further directions applicable to the apple tree, as well as the pear tree, will be given in treating of the latter.

Espaliers.—This mode of training is well adapted for the apple either in large or small gardens. Of all others, it occupies the least space, and allows of the ground between the rows being closely, if judiciously, cropped to within 1 foot of the trees. The latter are by this mode easily managed; and the fruit can be well exposed to the sun's rays and to the

free access of air; whilst it is more secure from being blown down by wind than when it is grown either on standards or dwarfs. These advantages ought to more than counterbalance the only drawback, namely, the expense of the espalier rail, which, after all, may be erected at no great cost. This mode has long been in use in British gardens, yet it has been decried as an unproductive one. Certainly, we have seen many espalier trees that produced scarcely anything but wood; and, of course, annual disappointment was the result. It may be well, therefore, to point out the cause of this, in order that it may in future be avoided, and that espalier training may have the patronage which it deserves when conducted in a proper manner. It will, in the first place, be necessary to investigate the main source of the evil. We shall suppose that the horizontal branches have been trained at proper distances, and that the intended number of them has been obtained. A number of shoots will push in an upright direction from the upper sides of each horizontal, but more especially from the two upper ones. Each of the shoots on these will, from their position, command more sap than the shoots which constitute the leaders of the horizontals. Let us take one of them; if we allow it to grow during the season, and then cut it entirely off, it is so much of the vigour of the tree wasted; if it is cut to within a few inches of its base, at the autumn or winter pruning, two or more equally strong shoots will push in the ensuing season; and if each of these is treated at the next pruning like the original, a mass of shoots will result, so that that which was in the beginning but a single bud, will soon become a sort of burr, yielding crops of shoots like a willow stool. These vigorous shoots will contribute to form, on the branches on which they are situated, thicker layers of alburnum than will be deposited on the lower branches, furnished, as they are, with a less quantity of shoots, and connected with a less number of leaves, the organs in which the organizable matter is elaborated. The sap flows in greatest abundance into the branches which have the greatest thickness of alburnum, because there it finds the largest number of vessels; and accordingly a large share of the sap will flow towards the upper branches in the ensuing season to be again fruitlessly expended, instead of being equally distributed throughout the whole of the branches of the tree, and unpro-

ductiveness is the consequence. The cause having been traced to the buds on the upper branches, and more especially the buds on the upper sides of these branches being allowed to develop strong shoots, it is evident that the remedy consists in checking that tendency, and this is in fact the principal object to be kept in view in managing espaliers; for, however well they may be attended to in other respects, they will not afford a satisfactory result if that be neglected. Having arrived at this conclusion, we shall proceed to the management of the tree.

First Season.—This may date from the planting of the tree in autumn; it should then be cut down to 1 foot above the ground. Train the shoot from the uppermost bud upright in summer; also one to the right and another to the left, at an angle of 45° in the first instance, and if one grow stronger than the other, depress the strong and elevate the weak.

Second Season.—Cut back the upright shoot to about 1 foot from where it was formerly shortened, or to one bud above two buds eligible for forming a second pair of horizontals. These two buds should be a little below the horizontal line, along which the shoots from them are ultimately to be trained. Let the lowest two be brought to the horizontal position if strong, but only nearly to that position if weak. These lowest branches cannot be too strong; therefore, the shoots they produce should be allowed to grow unchecked, except so much as may be found necessary to prevent them from competing too much with the leaders.

Third Season.—Cut back the upright shoot as before, and shorten the laterals on the horizontals to about 2 inches. Shoots will push from the parts left, and they should be pinched when about 6 inches in length.

Proceed in this manner till the requisite number of horizontals is obtained. When the upright shoot is cut in order to obtain the two uppermost horizontals, only two buds should be allowed to push, a third one, for an upright, being no longer required.

The direction of the branches being that of horizontal lines at equal distances, the leaders have only to be trained in that direction, and the intended form of the tree will be insured. This part of the management is so simple that it requires no comment. It is, however, necessary to direct particular attention to the way

in which the flow of sap should be equalized, and, consequently, an equal degree of vigour maintained amongst the respective branches, and according as that equality is maintained, the more healthy and productive they will be; moreover, the fruit will be of better flavour than when some of the branches are starved, whilst others are over-luxuriant.

When the shoots begin to push in the early part of the season, inspect the tree, and take especial notice of the strongest branches, and also of the weakest. If any of the younger branches are thicker and more vigorous than those that are older, such ought not to have been the case, and equality must if possible be restored. The shoots on the strong branches must be kept well pinched in, commencing early; as soon as they have pushed five or six joints, they should be pinched immediately below the fifth one. The shoots on the weak branches, on the contrary, ought not to be pinched till they have attained a considerable length, and then they should be left long enough to bear a greater amount of foliage than those which are over-vigorous. By these means the weak branches will gain upon the strong. When that equality is regained, which, indeed, ought never to have been lost, it will still be necessary to commence summer pruning the upper branches first. Presuming that in the spring all the branches possessed an equal degree of vigour, and if, when the shoots pushed, they were all stopped or pruned equally and at the same time, the upper ones would gain an advantage over the lower, from the natural disposition of the sap to flow into the former in preference to the latter. Hence the necessity of always checking the young shoots in the upper parts of the tree before those in the lower. This is very easily done; and with regard to the other points of management, we presume that they will be understood from the explanations given, and that being the case, there will be no great difficulty in performing the necessary operations.

Wall-trees.—Although the apple is produced in perfection in the southern parts of the kingdom on standards, dwarfs, and espaliers, yet certain sorts are very generally provided with a wall in northern situations. Apple trees do not require the minute care that some other kinds of wall-trees do; yet, as walls are expensive, every kind of tree planted against them ought to be well managed and productive.

The first consideration is the mode of training which should be adopted. If the wall is low, the horizontal mode is decidedly the best, and so it is, likewise, for those of the usual height. In some particular cases, as against the high gable end of a house, the tree may be trained in the fan manner, in order that the wall may be the sooner covered. If the horizontal mode is the one adopted, the next consideration is the distance between the horizontal branches. For Nonpareils, and the weaker growing kinds of dessert apples, the distance may be three courses of bricks, or 9 inches; but for vigorous, large-leaved sorts, 12 inches, or four courses of bricks, will be preferable. In cold situations, this width is not too much; for if part of the surface is not covered with foliage, the sun's rays acting directly against the naked bricks, will heat the wall to a much higher degree than if the surface were entirely covered with foliage. Whether the distance between the branches be 9 or 12 inches, the lowest should be 1 foot from the ground. But the upright leading shoot ought to be cut back, so that the two buds intended to originate the lowest pair of horizontals may be about 9 inches above the surface, thus allowing them 3 inches of an ascent to the line by which they are afterwards to be trained. The next pair of horizontals may be allowed nearly as much; the third course of horizontals somewhat less than the preceding, and so on till near the top, where the branches may proceed at right angles from the stem. In some cases two courses of horizontals may be taken in the same season, cutting back the upright shoot to one bud above the place from which the side shoots are required to push. This should not be done later than the end of June.

The directions for maintaining equality of vigour among the branches of espalier-trained trees, are likewise applicable to those trained on walls. The summer pruning, and the pruning of the spurs in winter, are conducted in the same manner as with the pear, to which article we refer for further particulars.

Gathering and Storing the Crop.—The period for gathering any particular sort of apple cannot be precisely stated, for it varies in different localities according to the soil and climate, and even in the same locality in different seasons. In light, dry soils, the fruit will not hang so long as in those that are of a stronger nature. The dropping of unsound fruit is no criterion;

but when that which is sound begins to fall, the crop may be gathered. Or, the apple may be tried without pulling, and if the stalk then parts easily from its connection with the spur, it is fit to gather; but if it hold firmly at that place, so that in order to separate the fruit it must be twisted and broken, then fruit has not attained the degree of maturity which the tree can afford. When this is the case, the seeds are of a brownish colour. Some early sorts of apples ripen in succession, and should be gathered accordingly; such, indeed, require particular attention in respect to gathering; for if taken a few days too soon, they are watery; if a few days too late, they are mealy. Dry weather is to be preferred; but if the season is wet, the apples must sometimes be gathered when wet, in which case they should be spread thinly in an airy place to dry. In gathering, great care should be taken not to bruise the fruit by any means. The gathering baskets ought to be lined with some soft substance, and too many fruits should not be placed above each other. Indeed, choice apples, and such as are intended to be kept through the winter and spring, should be laid singly on a light hand-barrow, the bottom of which is of large area and lined with a mat or cloth; over this first layer another mat or cloth should be spread, and then a second layer may be placed in the barrow. The apples should be taken out by hand and not tumbled out of the baskets, for fruit that will bear considerable pressure without bruising, will nevertheless give way under a slight percussion. The effect may not be apparent at the time, except by a small depression, but afterwards it will be found, on removing the skin, that the flesh immediately beneath it exhibits a derangement of tissue and a change of colour, a disposition to decay being the consequence.

The late-keeping sorts should be stored in a place where the exhalations from ripe and nearly ripe fruit cannot reach them. The latter could be kept in baskets lined with some well-dried straw, and placed above each other. If the quantity of apples fit for use be too large for the space that can be allotted for them in the fruit-room, they may be laid in heaps on the floor of a loft or other place where there is a free circulation of air, which, though necessary, cannot, however, be admitted at all times without occasioning vicissitudes of temperature. If the air is cold for several days and nights, the fruit will also become

cold, and if the air should get suddenly warm, the apples will get wet from condensation. In order to protect them from being affected to any considerable extent by sudden changes of temperature, it is advisable to cover them about 1 inch thick with straw made very dry by exposure to the sun, or by placing it on a kiln. The straw will absorb any moisture that may arise from the fruit, which will ripen of a fair colour and be more plump than if fully exposed to the air.

The most essential points in keeping apples are coolness and a steady temperature, with no greater circulation of air than is absolutely necessary to prevent exhalations from accumulating, and they should not be kept in the dark. They keep very well packed in dry fern, kiln-dried straw, or dry silver sand; they should not, however, be buried in the latter to any great depth, for if almost entirely excluded from the air they lose their flavour. When hermetically inclosed, fruit becomes insipid, although it may seem quite perfect as regards external appearance. The fruit may also be preserved very well in clean, dry ware casks; for packing in these, the apples should be carefully selected, all that are in any way bruised or specked being rejected. After having been in the cask for two or three weeks, it should be opened and the whole picked over, so that any that may then give indications of decay may be removed. Those which do not exhibit symptoms of this process taking place will, on being repacked, keep plump till fit for use, if the cask be put in a dry cool place.

Diseases and Insects.—The diseases to which the apple tree is chiefly subject are *canker* and *mildew*.

Canker, it is well known, attacks some varieties more than others growing in the same soil. Hence, it must be inferred, that some varieties are constitutionally more disposed to this disease than others; again, in some soils, almost every variety is, more or less, subject to canker, whilst in others the whole of them are comparatively free from it. The cause is imperfectly understood, and so, consequently, is an effectual remedy. It probably arises from a combination of causes, over which we can have no complete control. We may mention sudden checks to the vegetation of the tree, especially in spring and the early part of summer, derangements of the flow of sap from vicissitudes of heat and cold, as well

as of moisture and dryness, unskilful and severe pruning, and vitiation of the sap by deleterious substances in the soil or subsoil.

When a tree pushes rapidly in consequence of high temperature, and is then suddenly checked by cold, small lateral shoots, that have pushed to the length of 1 or 2 inches, are apt to die, and, in that case, canker takes place round their bases. As soon as this is observed, the dead shoot should be cut in very closely to the branch from which it springs, and the cankered bark ought to be cut entirely away. If this is done when the tree is in full growth, the wounds will heal rapidly. If trees canker where the soil has not been drained, draining should be immediately proceeded with, and beneficial results will certainly follow.

Dryness at the root doubtless gives rise to a species of canker which manifests itself on the younger branches and on the shoots. When the sap, from excessive dryness at the root, cannot be maintained in a proper state of fluidity, it cannot circulate so as to produce a healthy organization.

Severe and untimely pruning unquestionably induces canker. If a large limb is cut off late in spring, when the buds are just breaking, the sap must either overflow by the wounded surface and cause weakness, or it must stagnate, and when it does so, being partly in contact with the air, it very soon becomes vitiated, and the bark cankers; sometimes the latter shells off, leaving, in some instances, as much as 6 inches of a naked, dead stump, which requires to be cut off, and, even then, the wound is difficult to heal over as compared with a wound of similar extent made in autumn, or indeed at any other period, except that from the commencement of the active flow of sap, in spring, till the buds have fully expanded into leaf.

If canker attacks varieties that are not usually subject to it, and if the trees have not suffered from any of the above-mentioned causes, the evil may reasonably be attributed to some deleterious principle in the soil. If the canker is evidently progressing, and if the trees are not too old for removal, they had better be taken up, and the soil ameliorated by trenching and other means. In some cases a considerable portion of a bad substratum may be turned up to the top, where it will be comparatively harmless, and, besides, by exposure to the weather, and by cultivation, it

must there undergo a change for the better and when the soil turned down from the top to the bottom is reached by the roots of trees, the latter generally thrive well.

Mildew frequently attacks the foliage of the apple, and sometimes the extremities of the shoots. The soil should be examined, and care taken that it is not at any time too dry at the extremities of the roots. Removing the tree, trenching the ground, and replanting, have produced beneficial results, apparently by removing the cause by which mildew is induced. To act specifically, sulphur ought to be applied at intervals, commencing as soon as the first symptoms make their appearance.

Moss and lichens should be scraped off, but it is better if the trees can be made to thrive so well as to throw off the old bark, moss and all, as we have seen ill-thriving, moss-grown apple trees do, in consequence of draining the soil.

The American blight (*Eriosoma mali*, Leach; *Aphis lanigera* and *Eriosoma lanigera* of others) is one of the most troublesome and injurious of the insects which infest the apple, attacking both roots and branches, and frequently causing the death of the tree if remedial measures are not promptly adopted. At first sight, a fine, white, cottony substance, lodged in the crevices of the bark, is all that is apparent, but on closer examination, numerous small, wingless insects will be observed. These are, with the exception of the head, entirely covered with long, cottony filaments, and are furnished with a strong proboscis, by means of which they imbibe the sap of the tree. Various remedies, such as scrubbing with soap-suds and then painting with lime-water, washing with tobacco-water, soap-lees, vinegar, or sulphuric acid diluted with water, as well as painting with clay, have been recommended, and are practised with more or less success; but the most effectual mode of freeing the trees from this pest is to wash them thoroughly with water applied through a powerful garden engine. The insects, which are dashed down to the ground in consequence of this proceeding, though seldom capable of doing much injury afterwards, should be removed from near the tree by means of the hoe, and the ground, as far as the branches extend, ought to be hoed and raked. When the roots are attacked, it is generally those nearest the surface that suffer the most. All that can be safely done, in this case, is to dig out the old soil to the depth of 6 or 8 inches,

and to the distance of 2 or 3 feet from the stem, and after washing the roots well, to replace it with fresh. Afterwards the old soil should either be burned or removed to a part of the garden where fruit-trees are not cultivated.

The apple-tree mussel scale (*Aspidiotus conchiformis*) is occasionally troublesome, especially in the case of trees trained against walls. It may, however, be exterminated by scraping the bark with a wooden spatula, or by using a scrubbing-brush and sand, a little quicklime having previously been strewed round the base of the stem. The bark should afterwards be washed clean with soap and water, a proceeding which is greatly conducive to the health of the trees. The best time for performing these operations is in May, when the young brood begins to make its appearance from beneath the scales.

The apple-bark beetle (*Bostrychus dispar*) bores into the stem and branches in order to deposit its eggs, but is seldom, if ever, found in this country.

The stem-boring weevil (*Rhynchites aliaræ*) sometimes does considerable injury by cutting over young shoots and grafts, in spring, after having deposited one or two eggs in each. In about a week, a small white grub is hatched, which feeds upon the pith of the shoot, and which, in a month afterwards, having attained its full size, buries itself in the earth; it remains there till spring, when the beetle appears. Collecting and burning the shoots cut over by the beetle, and in which the eggs are deposited, appears to be the only mode of destroying the insect in large plantations.

The caterpillar of the goat-moth (*Cossus ligniperda*) attacks the apple, as well as other fruit-trees, and does great mischief by boring long passages in the wood, thus inducing decay, and rendering the stems of young trees liable to be broken over by the wind. The willow and poplar are, however, its favourite food. It is one of the largest known species, remaining two years in the larva state, and measuring, when full grown, about 4 inches in length. The moth appears in June and July, and may generally be observed sitting in the neighbourhood of its cocoon, which may be seen protruding from the hole formed by the caterpillar. The only remedies are killing the moth, and destroying the caterpillars by thrusting a wire up the holes, into which tobacco smoke has also been recommended to

be blown. Recently, chloroform has been successfully employed for the same purpose.

The wood leopard-moth (*Zeuzera aesculi*) deposits its eggs in July and August in the crevices of the bark, and, in a few days, a yellow caterpillar is produced. This immediately proceeds to eat its way into the wood, and continues boring till full grown, at which time it is about $1\frac{1}{2}$ inch in length. It then makes its way towards the bark of the tree and changes into a pupa, from which the moth emerges in the following summer. Painting the stems with whale-oil soap is the best preventive to the attacks of the caterpillar, which may also be killed by blowing tobacco smoke into the holes.

Aphides, though subject to the attacks of numerous enemies, sometimes appear in such numbers as to prove prejudicial to the tree by exhausting it of its sap, in which case artificial means must be resorted to for their destruction. Syringing with a powerful garden engine, with or without the application of snuff afterwards, and dusting with newly slaked lime, are amongst the most approved remedies.

The caterpillar of the figure-of-8 moth (*Episema cæruleocephala*) occasionally devours the leaves, though it generally prefers feeding on thorn hedges. The moth deposits its eggs in autumn, and the caterpillar makes its appearance in the following spring. When full grown, it is about 2 inches in length, of a yellowish green colour, with one dorsal and two lateral pale yellow stripes, and a bluish head. In June it forms itself a case out of moss or chips of wood, either upon the trees or in crevices in the wall, changes into the pupa state, and appears as a moth in the following October, or later. Hand-picking the caterpillars at an early stage of their growth is the best means of preventing injury to the trees.

The caterpillars of the winter moth (*Hybernia brumata*) are very destructive to the apple, as well as to most other deciduous trees, devouring not only the buds, flowers, and leaves, but the young fruit also. When newly hatched in spring, they are of a grayish colour, and not thicker than a horse-hair, but when full grown are yellowish green, and about $\frac{1}{2}$ inch in length. About the end of May, they let themselves down by a thread to the ground, in which they bury themselves to the depth of 2 or 3 inches, and change into a pupa, from which the perfect insect comes

forth in November or December, and proceeds to deposit its eggs on the trees. The females, being wingless, must ascend the stem by crawling; they may, consequently, be caught by placing bands of brown paper or canvas, covered with tar or bird-lime, round the base of the stem. Digging round the trees in autumn, or removing the surface soil to the depth of 3 or 4 inches and burying it in trenches, may also be resorted to for the destruction of the insect in its pupa state.

The caterpillar of the small ermine apple-moth (*Yponomenta malivorella*) devours the leaves in spring and early summer, covering, at the same time, the shoots and branches with thick webs. In these it spins a cocoon, and changes into a chrysalis, from which a white moth emerges in the end of June. The remedies consist in destroying the pupæ and moths. With the latter object in view, Mr. Westwood recommends a sheet to be spread under the tree, and the branches to be sharply struck with a stick, when the moth, being sluggish during the day, will fall and be caught in the sheet.

The garden chafer (*Anisoplia horticola*) attacks the flowers as well as the foliage. If the beetles are numerous, they may be shaken at night into a cloth spread under the tree, and destroyed. The rapid increase of the insect is kept in check by birds, which devour multitudes of the larvæ.

The apple-weevil (*Anthonomus pomorum*) frequently does great injury to the crop. The beetle, having concealed itself in the ground, or beneath the bark during the winter, makes its appearance early in spring, and deposits a single egg in each of the flower-buds. In April a small white grub with a black head is produced, and this feeds upon the organs of fructification, causing the blossom to wither up before its expansion. In less than a month from the time of its being hatched, the grub is transformed into a beetle which feeds upon the leaves till autumn, when it seeks a place of concealment where it may pass the winter. Little can be done to lessen the numbers of this destructive insect except by keeping the trees clean, and removing loose bark and fallen leaves, beneath which the beetle might find shelter. Collecting and burning the withered blossoms may also be resorted to with beneficial results.

The apple saw-fly (*Tenthredo testudinea*) appears in May, and deposits its eggs in the

blossoms, and the larva feeds upon the interior of the young fruit, which generally falls to the ground when about the size of a walnut. The caterpillar then eats its way out, and forms a cocoon in the earth, where it remains till the following season. Collecting the fallen fruit and destroying it by fire, or by burying it deeply in the ground, is the only mode of preventing the further attacks of this insect.

The purple apple-weevil (*Rhynchites Baccus*) deposits its eggs about midsummer in the interior of the fruit, and in a few days a small whitish grub is hatched. After feeding upon the flesh of the apple for three or four weeks, it quits it, and buries itself in the earth, where it remains during the winter. Shaking the trees early in the morning during the months of June and July, so as to cause the beetles to fall, and then destroying them, as well as collecting the perforated fruit, are the best means of limiting the attacks of the insect.

The codling moth (*Carpocapsa pomonana*) deposits its eggs either at the stalk or eye of the young fruit, early in May. In a few days a small whitish grub is hatched, and this immediately eats its way into the apple, upon the substance of which it feeds for three weeks or a month. Having by that time attained its full size, the grub quits the fruit, which in the interval generally falls to the ground, spins itself a cocoon on the stem, and changes into a chrysalis, from which the moth appears in a few days and gives rise to a second brood of grubs. Destroying the fallen apples, and keeping the stems free of loose bark, are the best preventive measures.

In addition to the above, the following insects may also be mentioned as attacking the apple, namely, the caterpillars of the lackey moth (*Clisiocampa neustria*), mottled umbric moth (*Hybernia defoliaria*), pale brindled beauty-moth (*Amphidasis pilosaria*), gipsy-moth (*Bombyx dispar*), yellow-tailed moth (*Bombyx chrysorrhæa*), the lunar spotted pinion-moth (*Noctua pyralina*), and the hawthorn pontia (*Pieris crataegi*).

According to Downing, the apple tree suffers in America from three insects which, though not troublesome in Britain, it may be well to mention.

The apple-borer is a fleshy, white grub, the larva of a brown and white striped beetle (*Saperda bivittata*), which deposits its eggs during the months of June and July in the

collar of the tree. The grub, which takes two or three years to go through all its transformations, penetrates into the stem, and eventually causes the death of the tree, either by its perforations or by consuming the alburnum. It may be destroyed by thrusting a wire into its hole, and its attacks prevented by placing a mound of ashes round the stem; also, to a great extent, by washing the stem with a solution of 2 lbs. of potash in 8 quarts of water.

Another insect pest is the caterpillar of a reddish brown moth (*Clisiocampa Americana*), the eggs of which are deposited about mid-summer on the young branches. The caterpillars are hatched in the following May, and feed voraciously on the foliage for six or seven weeks, often completely stripping the trees. The most effectual remedies are hand-picking, brushing the caterpillars down with a round brush fixed to the end of a pole, or touching them with a sponge dipped in strong spirits of ammonia, when they instantly perish; but whatever mode of destruction be adopted, it should be practised early in the morning, before the insects quit their nests.

The canker worm (*Anisopteryx pometaria*) proves very destructive to the foliage in some parts of America. The moth occasionally appears late in autumn, but more commonly early in spring; and the females being wingless, are obliged to crawl up the stems, on which, after pairing, they deposit their eggs. The larva, which is ash-coloured or dusky brown, appears in the end of May. The most effectual means of checking the ravages of this insect consist in surrounding the stem with a piece of canvas smeared with bird-lime, so as to entrap the females in their ascent.

THE PEAR (*Pyrus communis*, L.—*Icosandria* Di-Pentagynia, L.; Rosaceæ, J.; Pomaceæ, Lind.) is a native of England, as well as most temperate parts of Europe and Western Asia. It attains a greater height than the apple, and generally assumes a more pyramidal form of growth. Under favourable circumstances it lives to a great age, in some instances upwards of 400 years. It was cultivated more than 2000 years ago by the Greeks and Romans; and the cultivated varieties are supposed to have been introduced by the latter into Gaul, and from thence into England.

The uses of the fruit are well known; for the dessert it is highly esteemed, and many

varieties are excellent for stewing, baking, drying, and for the manufacture of perry.

The varieties cultivated for these purposes are scarcely less numerous than in the case of the apple, and new ones are being continually added. By the exertions of Mr. Knight in our own country, and of Van Mons, Esperen, and others, in Belgium, many valuable sorts have been obtained, which have proved superior in hardiness and quality to the older kinds, and have rendered the cultivation of some of these no longer desirable. The quality of the fruit and bearing in this country of many of the most recent Belgian sorts have not, however, as yet been sufficiently ascertained to permit of our speaking of these varieties with certainty; we shall therefore confine ourselves in the following descriptions to sorts which are known to be of first-rate excellence in this country.

I.—DESSERT PEARS.

1. **ALTHORP CRASSANE.**—*Shoots* vigorous, olive brown, marked with numerous pale brown dots. *Leaves* rather large, ovate, acuminate, somewhat cordate at the base, dentate or slightly serrated. *Petioles* nearly 1 inch in length. *Fruit* middle-sized, roundish obovate. Eye partially open, the segments of the calyx inclining to collapse, set in an evenly formed depression. Stalk from $\frac{1}{2}$ inch to 1 inch in length, of medium thickness. Skin greenish brown, in some cases becoming but very faintly tinged with yellow when fit for use. Flesh pale greenish white, buttery, melting, very juicy, rich, and excellent, with a slight rose-water perfume.

A dessert pear of the highest merit; in use in the end of October and throughout November.

The tree is vigorous, very hardy, and a good bearer as a standard, even in unfavourable years.

The variety was raised by Mr. Knight.

2. **AMBROSIA**—syn. Early Beurré.—*Shoots* very vigorous, dark brown, sprinkled with linear specks. *Leaves* large, oval, acuminate, very sharply serrated. *Petioles* about 1 inch in length. *Fruit* middle-sized, roundish obovate. Eye large, open, set in a shallow depression. Stalk about 1 inch in length, thickened at its base, inserted, frequently obliquely, in a small cavity. Skin greenish yellow, thickly sprinkled with pale brown spots and smooth russet. Flesh whitish, buttery, melting, and rich, with a honied sweetness.

A delicious dessert pear; ripe in September, but only keeping good for a few days.

The tree is an upright and moderately strong grower, and succeeds as a standard.

3. ASTON TOWN. — *Shoots* long, vigorous, erect, of a dark olive colour, strewed with small pale brown specks, slightly downy. *Leaves* rather small, ovate, abruptly acuminate, serrated near the apex, almost entire towards the base. *Petioles* scarcely 1 inch in length, strong. *Flowers* rather small. *Petals* roundish obovate. *Fruit* below the middle size, roundish. *Eye* small, open, placed in a shallow depression. *Stalk* long, slender, not sunk at its insertion. *Skin* pale gray, with specks of russet on the side next the sun. *Flesh* yellowish white, melting, very juicy, rich, and sugary, with a Crassane flavour.

An excellent dessert pear; in season in October and November, but not in perfection till the end of the former month.

The tree is very hardy, and well adapted for cultivation as a standard, bearing abundantly as such even in exposed situations. Its branches, when allowed to grow at full length, have a peculiar tendency to twist or curve, and in forming the heads of standards this must be counteracted by judicious pruning.

The variety was raised at Aston in Cheshire.

4. AUTUMN BERGAMOT—syn. Common Bergamot, English Bergamot, York Bergamot.—*Shoots* moderately strong, olive brown, thinly sprinkled with pale brown dots. *Leaves* middle-sized, oval or ovate, somewhat cordate and acuminate, finely serrated. *Petioles* about 1 inch in length, slender. *Flowers* middle-sized. *Petals* roundish obovate, imbricated, of a cream colour. *Fruit* rather small, depressed globular. *Eye* middle-sized, open, set in an evenly formed, shallow depression. *Stalk* short and thick, inserted in a rather wide, round cavity. *Skin* brownish green on the shaded side, reddish brown next the sun, the whole surface sprinkled with spots and specks of rough brown russet, and sometimes entirely covered with it. *Flesh* whitish, tender, gritty near the core, sugary, and rich, with an abundance of perfumed juice.

A very good dessert pear; in season during October.

The tree is moderately vigorous, hardy, and a good bearer, even as a standard.

The variety is supposed to have existed in this country for upwards of 1800 years.

5. BERGAMOTTE CADET -- syn. De Cadet,

Beauchamps, Beurré Beauchamps.—*Shoots* of medium length and thickness, dull brown, with very few obscure, linear, pale brown dots. *Leaves* small, oval, somewhat acuminate, very sharply serrated. *Petioles* short, about $\frac{1}{2}$ inch in length. *Flowers* middle-sized. *Petals* oval. *Fruit* middle-sized, roundish obovate. *Eye* small, set in a shallow depression. *Stalk* rather short and thick, not deeply inserted. *Skin* pale green on the shaded side, yellowish brown next the sun, partially covered with soft russet. *Flesh* yellowish white, buttery, juicy, rich, and sweet, with a peculiarly agreeable perfume.

An excellent dessert pear, valuable on account of its ripening in succession from October to January, and in some cases continuing to do so from the same tree till March.

The tree is vigorous, hardy, and a good bearer, succeeding as a standard in England.

6. BEURRÉ D'AMANLIS — syn. D'Albert, Hubard, Kaissoise, Wilhelmine.—*Shoots* vigorous, dark chestnut brown, sprinkled with rather large pale brown specks. *Leaves* large, broad oval, acuminate, very sharply serrated. *Petioles* $\frac{3}{4}$ inch in length. *Fruit* large, obovate. *Eye* open, set in a shallow depression. *Stalk* long, moderately thick, inserted in a shallow cavity. *Skin* yellowish brown where shaded, tinged with brownish red next the sun, and sprinkled with russet. *Flesh* yellowish white, buttery, melting, and rich.

A handsome and excellent dessert pear; in season in September and October.

The tree bears well as a standard.

7. BEURRÉ D'AREMBERG — syn. Duc d'Artemberg, D'Artemberg Parfait, Colmar Deschamps, Deschamps, Délices des Orphelines, L'Orpheline, Orpheline d'Enghien. — *Shoots* moderately vigorous, of a clear yellowish brown, and sprinkled with small, oblong, light brown spots. *Leaves* middle-sized, oblong, tapering to the point, somewhat folded, nearly entire on the old wood, slightly serrated towards the extremities of the young shoots, the mid-rib frequently much recurved towards autumn. *Petioles* of medium length, moderately strong. *Fruit* middle-sized, obovate, with a fleshy protuberance on one side of the stalk. *Eye* small, set in an evenly rounded cavity, the segments of the calyx in many cases entirely disappearing. *Stalk* about 1 inch in length, thick, generally inserted nearly at right angles with the axis of the fruit. *Skin* pale green, dotted with cinnamon russet. *Flesh* whitish, melting,

very juicy, and when well ripened, rich and sweet, with a slight, agreeable acidity, but which in unfavourable seasons and localities becomes disagreeable to most persons.

An excellent dessert pear; in season during December and January.

The tree is moderately vigorous, and a great bearer, succeeding as a standard in good situations, but better as an espalier, or against a wall.

8. **BEURRÉ BOSC**—syn. *Calebasse Bosc*, *Bosc's Flasehenbirne*, *Marianne Nouvelle*, *Beurré d'Yelle* of some.—*Shoots* vigorous, flexuose at the buds, olive, sprinkled with distinct pale brown dots. *Leaves* rather large, ovate, acuminate, slightly crenated. *Petioles* about 1 inch in length. *Petals* long, elliptical, not imbricated. *Fruit* large, pyriform, a little curved. *Eye* rather small, open, inserted in a shallow depression. *Stalk* about $1\frac{1}{2}$ inch in length, slender, curved. *Skin* tolerably smooth, entirely covered with cinnamon russet. *Flesh* yellowish, buttery, juicy, rich, and sugary, with a very agreeable, cinnamon flavour.

A handsome and excellent dessert pear; in season during October and November.

The tree is hardy, vigorous, and a good bearer either as a standard or against a wall. The fruit does not generally form in clusters, but is distributed singly over the tree.

The variety was raised by Dr. Van Mons.

9. **BEURRÉ DE CAPIAUMONT**—syn. *Aurore*, *Capiaumont*, *Calebasse Voss*.—*Shoots* vigorous, of a clear reddish brown colour, sprinkled with numerous white spots. *Leaves* large, ovate oblong, much folded, acuminate, finely serrated. *Petioles* $\frac{3}{4}$ to 1 inch in length. *Fruit* middle-sized, turbinate, tapering generally with a slight curve. *Eye* large, open, prominent. *Stalk* generally short, thickened at its base, and continuous with the fruit. *Skin* yellow on the shaded side, of a fine cinnamon colour with a blush of light red next the sun, the whole surface sprinkled with slight russet. *Flesh* yellowish white, melting, buttery, juicy, rich, sweet, and pleasant.

An excellent dessert pear; ripe about the middle of October, and keeping till the end of that month or beginning of November.

The tree is hardy in constitution, and its blossom is not liable to injury from frost. It is a great bearer either as a standard or open dwarf.

10. **BEURRÉ DIEL**—syn. *Beurré Incompar-*

able, *Beurré Magnifique*, *Beurré Royal*, *Diel*, *Dillen*, *Gros Dillen*, *Dorothée Royale*, *Grosse Dorothée*, *De Melon*, *Melon de Kops*, *Des Trois Tours*, *Diel's Butterbirne*, *Beurré Spencee* and *Beurré d'Yelle* of some.—*Shoots* strong, of a dull olive brown, sprinkled with a few small, linear, ash-coloured specks, slightly downy, especially at the extremities. *Leaves* large, roundish ovate, acuminate, nearly flat, finely and irregularly serrated. *Petioles* from $\frac{3}{4}$ inch to 1 inch in length. *Flowers* large. *Petals* roundish oval, imbricated. *Fruit* very large, varying greatly in form according as it is produced on a wall or in the open ground, obovate in the latter case, obtusely pyriform in the former, thickest a little above the middle, tapering from thence pretty regularly towards the stalk, but there it is obtuse, and some obtuse angles proceed from the middle towards the other extremity when the fruit assumes the elongated form. *Eye* open, set in an uneven hollow, which is generally deep, sometimes rather shallow. *Stalk* strong, from 1 to $1\frac{1}{2}$ inch in length, placed in a deep cavity, and surrounded by fleshy protuberances. *Skin* smooth, greenish brown at first, changing towards maturity to brownish yellow, and sprinkled with cinnamon-coloured russet. *Flesh* yellowish white, buttery, melting, a little gritty near the core, juicy, and sweet, with a rich, aromatic flavour.

A dessert pear of the highest excellence; in season from the end of October to the beginning of December.

The tree is very vigorous, attaining a large size, hardy, and a most abundant bearer either as a standard or upon a wall. Grown in the latter mode, its fruit is inferior in flavour to that produced by standards, dwarfs, and espaliers, though of larger size.

In pruning the tree, care should be taken to admit air and light to the large foliage by thinning out the shoots to a sufficient extent.

The variety was named after Dr. Diel, the celebrated German pomologist, by Van Mons, who is said to have been its raiser.

11. **BEURRÉ RANCE**—syn. *Beurré de Ranz*, *Beurré Epine*, *Beurré de Flandre*, *Beurré Noirchain*, *Bon Chrétien de Rance*, *Hardenpont du Printemps*, *Ranzige Butterbirne*.—*Shoots* moderately strong, brownish yellow, sprinkled with distinct and rather numerous roundish gray spots. *Leaves* middle-sized, ovate, taper-pointed, toothed or not deeply serrated. *Petioles* short, generally from $\frac{1}{2}$ to $\frac{3}{4}$ inch in

length. *Flowers* rather early, large. Petals roundish oval, imbricated. *Fruit* large, obtusely pyriform. Eye rather large, open, with the segments of the calyx projecting. Stalk long, slender, inserted in a shallow depression. Skin dark green, thickly sprinkled with specks of dark brown russet. Flesh greenish, melting, a little gritty near the core, very juicy, rich, and sweet, not apt to become mealy.

A handsome and most delicious long-keeping dessert pear; in season from January till April or May.

The tree is moderately vigorous, of a rather straggling habit of growth, tolerably hardy, and an abundant bearer either as a standard or upon a wall. When grown on a wall, it succeeds best on a western aspect, but in cold situations it fully deserves a place on a southern aspect. It should be worked upon the pear stock, as it does not thrive upon the quince.

The variety was raised at Mons, by M. Hardenpont.

12. BISHOP'S THUMB.—*Shoots* moderately strong, of a twisted growth, yellowish brown, thinly sprinkled with dull pale brown specks. *Leaves* middle-sized, ovate oblong, acuminate, rather sharply serrated. Petioles 1 inch or more in length. *Fruit* large, oblong, thickest near the eye, where the sides are a little flattened, tapering irregularly towards the stalk, where it terminates somewhat obtusely. Eye small, open, set in a slight depression, and having the segments of the calyx projecting. Stalk rather long, curved, obliquely inserted between fleshy protuberances. Skin on the shaded side brownish green, sprinkled with numerous spots and patches of russet, and entirely covered with it at the base and towards the stalk, of a dark ferruginous red on the side next the sun. Flesh yellowish white, melting, juicy, rich, and sweet, with a peculiar perfumed flavour which is much relished by some.

A dessert pear; ripe about the end of October.

The tree is a good bearer as a standard.

13. BROOM PARK.—*Shoots* rather slender, thorny, olive-coloured, tinged with red towards the extremities. *Leaves* small, ovate, acuminate, slightly toothed or serrated. Petioles slender, $\frac{3}{4}$ inch in length. *Fruit* middle-sized, roundish obovate. Eye large, open, rather deeply sunk. Stalk thick, about 1 inch in length, not sunk at its insertion. Skin brown, sprinkled with cinnamon russet. Flesh yellowish white, melting, and juicy, with a rich

and peculiar flavour, partaking of the melon and pine apple.

An excellent dessert pear; in use during January.

The tree is vigorous, very hardy, and a good bearer as a standard.

The variety was raised by Mr. Knight.

14. BROWN BEURRÉ—syn. Beurré, Beurré d'Ambleuse, Beurré d'Amboise, Beurré Doré, Golden Beurré, Beurré Gris, Beurré du Roi, Beurré Rouge, Beurré Vert, Badham's, Isambert, Isambert-le-Bon, Red Beurré of some.—*Shoots* moderately strong, short-jointed, of a bright chestnut colour, strewed with pale brown dots. *Leaves* rather large, oblong, inclining to ovate, tapering to the point, folded, irregularly dentate. Petioles about 1 inch in length, of medium thickness. *Flowers* middle-sized. Petals obovate, not much tinged with red. *Fruit* generally large, obovate, tapering to the stalk. Eye small, partially closed, set in a shallow depression. Stalk from $\frac{1}{2}$ inch to 1 inch in length, thick and fleshy at its junction with the spur, thickened and somewhat twisted at its base. Skin greenish yellow, covered more or less with thin russet, and tinged to a greater or less extent with reddish brown on the side next the sun. Flesh white, with some greenish veins, buttery, very juicy, and rich.

A valuable, highly esteemed, and, when well ripened, most excellent dessert pear; in perfection during October. It is, however, subject to considerable variation in size, form, colour, and quality, according to the soil and situation in which it is grown.

The tree requires the protection of a wall with a west aspect; and in northern situations it should have a southern aspect. It is a good bearer, vigorous and healthy in a warm climate, but very apt to canker in this country.

15. BURGERMEESTER.—*Shoots* moderately vigorous, yellowish brown, rather thinly sprinkled with oblong specks. *Leaves* middle-sized, ovate, tapering to the point, finely toothed, almost entire at the base. Petioles of medium length. *Fruit* middle-sized, oblong pyriform. Eye open, level with the top, somewhat oblique. Stalk about 1 inch in length, fleshy at its junction with the fruit, near which the latter is a little twisted, so that the stalk points in one direction, whilst the eye inclines to the opposite one. Skin greenish yellow, mostly covered with cinnamon russet. Flesh yellowish white, tender, melting, and very sugary.

A dessert pear; in season in November.

The tree is a good bearer, and succeeds as a standard.

16. CHAUMONTEL—syn. Beurré d'Hiver, Winter Beurré, Bezi de Chaumontel, Oxford Chaumontel.—*Shoots* rather slender, flexuose at the buds, bright chestnut red next the sun, paler chestnut where shaded, sprinkled with oblong, oval, and linear pale brown specks. *Leaves* middle-sized, ovate, with a tapering point, finely serrated. *Petioles* about $\frac{3}{4}$ inch in length. *Fruit* very large when well grown, oblong, blunt at the stalk, somewhat irregular, widest about two-thirds from the stalk, obtusely angular towards the eye, which is small, partially open, in a deep, irregularly ribbed cavity. Stalk short, thick, obliquely inserted in a narrow, irregular, moderately deep cavity, but often without being sunk, and having a curved projection of the fruit on its upper side. Skin on the shaded side yellowish green or olive brown, covered where well exposed with dark reddish brown russet. Flesh yellowish white, melting, juicy, and sugary, with a peculiarly rich, perfumed flavour.

A delicious dessert pear; in season from November to March.

The tree bears well as a standard in the southern parts of England, but elsewhere requires a wall. It is particularly well adapted for pyramid and espalier training, either on the quince or pear stock.

The Chaumontel is much grown in Jersey and Guernsey, and is the sort chiefly imported from these islands to London, where it is often sold at the rate of £5 per hundred when pears are scarce.

The original tree of this variety was a seedling which sprung up at Chaumontel (Oise) where, according to Duhamel, it existed in 1765, and though 100 years old, was still bearing good crops.

17. CITRON DES CARMES—syn. Madeleine, Rose Angle Early.—*Shoots* vigorous, chestnut-coloured, with numerous specks. *Leaves* middle-sized, ovate, somewhat cordate at the base, tapering to the point, entire, or but very slightly crenated. *Petioles* upwards of 1 inch in length. *Flowers* early, large. *Petals* roundish, imbricated, of a pale colour. *Fruit* middle-sized, obovate, rising a little higher on one side of the stalk than on the other. *Eye* rather large, open, set in a very shallow depression. Stalk long, rather strong, somewhat obliquely attached. Skin soft, smooth, yel-

lowish green, with sometimes a faint blush of red next the sun. Flesh greenish white, melting, juicy, sweet, and rich.

A most excellent early dessert pear; ripe in the end of July and beginning of August.

The tree is a vigorous upright grower when young; but when old, it is apt to canker in some soils. It is an abundant bearer as a standard.

18. COLMAR—syn. Colmar Doré, D'Auch, De Manne, Incomparable.—*Shoots* vigorous, yellowish brown, moderately sprinkled with distinct spots. *Leaves* middle-sized, ovate, tapering towards the point, slightly acuminate, finely, not deeply serrated. *Petioles* about 1 inch long. *Fruit* middle-sized, or rather large, oblong, tapering towards the stalk, at the insertion of which it is obtuse. *Eye* large, open, in a rather deep, evenly rounded hollow, on the sides of which the segments of the calyx closely recline. Stalk 1 inch in length, inserted somewhat obliquely in a slight depression. Skin grayish green. Flesh yellowish white, tender, juicy, rich, and high-flavoured.

In season in November, and may be kept till March.

There is perhaps no pear which will continue good so long after it becomes fit for use as this excellent variety.

The tree requires a wall, and is sometimes a shy bearer; but in favourable situations it is very productive.

19. COMTE DE LAMY—syn. Beurré Curté, Dingler, Marie Louise Nova, Marie Louise the Second.—*Shoots* very long and vigorous, dark reddish chestnut, with a moderate sprinkling of small round dots. *Leaves* rather large, oval, acuminate, sharply and irregularly serrated. *Petioles* rather more than $\frac{3}{4}$ inch in length. *Fruit* middle-sized, roundish obovate, broad at the eye, which is large, open, set in a wide depression. Stalk about $\frac{1}{2}$ inch in length, of medium thickness. Skin smooth, yellowish green, tinged with red and speckled with the same colour on the side next the sun. Flesh yellowish white, tender, melting, juicy, exceedingly rich and delicious.

A dessert pear of great excellence; in use during October.

The tree is vigorous, of upright growth, and a very abundant bearer, succeeding well as a standard.

20. CRASSANE—syn. Bergamotte Crassane, Beurré Plat, Crésane.—*Shoots* of medium

strength, brown, with a thin, grayish epidermis where exposed, yellowish brown where shaded, moderately sprinkled with gray dots. *Leaves* middle-sized, ovate-oblong, tapering to the point, slightly crenated. Petioles from $\frac{3}{4}$ inch to 1 inch in length. *Fruit* middle-sized, or rather large, roundish or turbinate, flat at the eye and a little so at the stalk. Eye small, open, set in a shallow depression, but sometimes rather deeply sunk. Stalk remarkably long, from 2 to $2\frac{1}{2}$ inches in length, slender, woody, but fleshy at its insertion, which is on a level or sometimes in a slight hollow. Skin a little rough, grayish green, dotted with brown, and occasionally sprinkled with russet. Flesh whitish, buttery, rather gritty near the core, juicy, with a rich, saccharine flavour.

An old and much esteemed dessert pear; in season during November and December.

The tree requires a wall, and is sometimes shy in commencing to bear, but afterwards it is frequently very productive.

21. DOYENNÉ D'ÉTÉ—syn. Beurré d'Été, Doyenné de Juillet, Saint-Michel d'Été.—*Shoots* moderately vigorous, of a clear olive yellow, sprinkled with pale brown dots. *Leaves* rather small, oval, tapering to the point, moderately serrated. Petioles about 1 inch in length, slender. *Fruit* small, obovate. Eye closed by the convergent tips of the segments of the calyx. Stalk scarcely 1 inch in length, thick. Skin pale yellowish green on the shaded side, streaked with deep red next the sun. Flesh white, melting, juicy, rich, and sweet, with a very agreeable flavour, which is free from muskiness.

A handsome and very excellent early dessert pear; ripe about the middle of July.

The tree is a most abundant bearer.

22. DUCHESSE D'ANGOULÊME—syn. Poire d'Éparonnais, Poire de Pézénas.—*Shoots* vigorous, olive, faintly tinged with red where well exposed, sprinkled with small, oval, and linear specks. *Leaves* rather large, oval, tapering to the point, acutely crenated. Petioles about 1 inch in length. *Fruit* very large, obtusely obovate, with an uneven, somewhat knobby surface. Eye partially open, set in a deep cavity. Stalk of medium length, stout, deeply inserted, and surrounded with knobby protuberances. Skin dull yellow, sprinkled with numerous spots and patches of brown russet. Flesh yellowish white, buttery, melting, very juicy, rich, and high flavoured, with a peculiar spicy aroma.

A very large dessert pear, of the highest excellence; in use in October and November.

The tree is healthy, vigorous, and a good bearer either as a standard, espalier, or against a wall. It produces the best flavoured fruit when trained as a standard or espalier, but requires a wall in the colder parts of the kingdom.

The variety is said to have been found in a hedgerow, near Angers, in 1815.

23. EASTER BEURRÉ—syn. Bergamotte de la Pentecôte, Beurré Anglaise, Beurré d'Hiver de Bruxelles, Beurré de Pâques, Beurré de la Pentecôte, Beurré Rousse, Bezi Chaumontel très Gros, Canning, Chaumontel très Gros, Doyenné d'Hiver, Doyenné d'Hiver Nouveau, Doyenné de Pâques, Doyenné du Printemps, Philippe de Pâques, Du Pâtre, Seigneur d'Hiver, Grüne Winter Butterbirne, Bergamotte d'Hiver and Pastorale of some.—*Shoots* moderately strong, of a clear reddish brown, sprinkled with well defined light brown or whitish dots. *Leaves* oblong or elliptical, slightly folded, somewhat recurved, slightly serrated. Petioles longish, slender. *Flowers* rather early, middle-sized. Petals oval, not imbricated when fully expanded. *Fruit* large, roundish obovate. Eye small, closed by the converging tips of the segments of the calyx, set in a moderately deep, somewhat irregular depression. Stalk very short and thick, inserted in a deep cavity, and surrounded by irregular projections. Skin brownish green, becoming yellowish brown at maturity, sprinkled with numerous russet spots. Flesh white, very buttery, melting, rich, sweet, and high flavoured.

A valuable late-keeping dessert pear; in season from January till April or May.

The tree is an early and most abundant bearer, especially when worked upon the quince stock. In the southern and midland parts of England it succeeds as an espalier, pyramid, or standard; in colder situations it requires a wall, but the fruit so produced is generally inferior in quality to that obtained from trees in the open ground. When grown as a standard, it should be as a low one, for the fruit being heavy is apt to be blown down. When the tree is trained against a wall with an east or west aspect, the branches should be placed at least 1 foot apart, in order to allow of a greater amount of heat being absorbed and radiated by the wall than would otherwise be the case. When the fruit becomes mealy, as it does sometimes upon a warm aspect, it

should be gathered before it parts easily from the spur, and ripened in a warm place.

The variety was introduced into this country from Belgium, but its origin is unknown.

24. ELTON.—*Shoots* vigorous, dull chestnut brown, slightly spotted, downy. *Leaves* middle-sized, ovate, acuminate, much waved on the margin, downy. *Petioles* long and slender. *Fruit* middle-sized, regularly formed, oval or obovate. *Eye* small, open, in a slight depression. *Stalk* short, inserted in a small cavity. *Skin* yellowish brown, slightly russeted. *Flesh* white, melting, buttery, juicy, and rich. The fruit is singular in not having any core.

A very good dessert pear; ripe in September. It must be gathered before it parts too readily from the tree.

The tree is an extraordinarily strong grower, and an excessive bearer.

The original tree was found in an orchard of pear trees in the parish of Elton, in Herefordshire.

25. ENGLISH CAILLOT ROSAT—syn. King Pear.—*Shoots* vigorous, yellowish brown, sprinkled with a few small linear specks. *Leaves* middle-sized, ovate, of thin substance, finely and sharply serrated. *Petioles* upwards of 1 inch in length. *Fruit* large, obtusely pyriform. *Eye* middle-sized, open, set in a shallow depression. *Stalk* about $1\frac{1}{2}$ inch long, of medium thickness, woody. *Skin* yellowish green, sprinkled with russet spots on the shaded side, dark brownish red, interspersed with some gray specks on the side next the sun. *Flesh* yellowish white, juicy, rich, and aromatic.

A good dessert pear; ripe in August.

The tree is vigorous, and a good bearer as a standard.

26. EYEWOOD.—*Shoots* of firm growth, but rather slender, short-jointed, often thorny, olive-coloured near the base, reddish chestnut where exposed, and deep red towards the extremities, marked with very few spots. *Leaves* very small, roundish ovate, somewhat acuminate, slightly toothed or serrated. *Petals* about $\frac{3}{4}$ inch in length. *Fruit* middle-sized, bergamot-shaped, but somewhat irregular. *Eye* open, set in a shallow depression. *Stalk* upwards of 1 inch in length, of medium thickness. *Skin* yellowish brown, mostly covered with cinnamon russet. *Flesh* yellowish white, melting, buttery, rich, and high flavoured.

A very good dessert pear; in season in October and November.

The tree is very hardy, and a good bearer.

This is one of the hardy varieties raised by Mr. Knight.

27. FIGUE DE NAPLES—syn. Comtesse de Fréol, Poire de Vigne Pelone.—*Shoots* strong, erect, dark brown, sprinkled with light brown spots. *Leaves* large, oblong, a little folded, entire, or slightly crenated. *Petioles* more than 1 inch in length. *Fruit* large, oblong, obtuse at the stalk, and of nearly equal thickness at both ends. *Eye* rather small, open, set in a very shallow cavity. *Stalk* very short, obliquely inserted without any depression. *Skin* thick, tough, brownish green on the shaded side, dark reddish brown, and strewed with numerous spots of brown russet on the side next the sun. *Flesh* greenish white, very melting, sugary, and rich.

An excellent dessert pear, in season during November; but unless kept in drawers, or otherwise preserved from the action of the air, it is apt to lose its melting properties.

The tree is very vigorous, and a great bearer either as a standard or dwarf.

28. FLEMISH BEAUTY—syn. La Belle de Flandre, Belle des Bois, Bergamotte de Flandre, Beurré des Bois, Bosch, Bosc Sire, Poire Brilliant, Bouche Nouvelle, Davy, Impératrice de la France, Tougard.—*Shoots* long, rather slender, dark reddish chestnut, with a purplish tinge, strewed with whitish dots. *Leaves* rather small, ovate, tapering to the point, slightly serrated. *Petioles* 1 inch or more in length, slender. *Flowers* middle-sized, early. *Petals* obovate. *Fruit* large, obovate, inclining to oval, terminating obtusely at the stalk. *Eye* small, open, set in a rounded shallow depression. *Stalk* of medium length and thickness, inserted in a small cavity. *Skin* greenish yellow, mostly covered with brown russet on the shaded side, and next the sun with reddish russet, which becomes of a vermilion colour when the fruit has completed its maturity. *Flesh* yellowish white, melting, buttery, juicy, rich, and sweet.

A handsome and excellent dessert pear; in use from the end of September to the end of October or later. The fruit must be gathered before it parts readily from the tree, or when it is just beginning to acquire a crimson tinge next the sun. After keeping some time, it will then come to its full perfection as regards flavour; but if allowed to hang on the tree till perfectly ripe, it will, though improving in size and appearance, become dry and worthless, and acquire a disagreeable anise flavour.

The tree is of spreading habit, and a good bearer, succeeding as a standard.

The variety, according to M. de Jonghe, was found at Heure, a village in East Flanders.

29. FONDANTE D'AUTOMNE—syn. Belle Lucrative, Seigneur Esperen.—*Shoots* vigorous, yellowish brown, chestnut-coloured near the extremities, on the exposed side thinly sprinkled with small spots. *Leaves* rather small, oval or ovate, acuminate, sharply serrated. *Petioles* nearly 1 inch in length. *Fruit* rather below the middle size, obovate, tapering to the stalk. Eye open, set in a shallow depression. Stalk about 1 inch in length, moderately thick, obliquely inserted in a small cavity. Skin soft, greenish yellow. Flesh greenish white, melting, very juicy, sugary, rich, and delicious.

An excellent dessert pear; in use in October.

The tree is healthy, and a good bearer as a standard.

30. FORELLE—syn. Trout Pear, Poire Truite, Forellenbirne.—*Shoots* vigorous, glossy, dark red tinged with violet, thinly sprinkled with pale gray spots, a little woolly towards the extremities. *Leaves* middle-sized, ovate, somewhat cordate at the base, acuminate, finely toothed. *Petioles* from 1 inch to 2 inches in length. *Fruit* middle-sized, obovate, sometimes oblong. Eye small, set in a rather shallow depression. Stalk slender, from 1 inch to 1¼ inch in length, inserted in a small cavity. Skin, when fully ripe, of a pale brown colour on the shaded side, tinged with vermilion, and strewed with numerous, roundish, bright gray spots, which are margined with crimson. Flesh white, very smooth, buttery, melting and rich, with an aromatic vinous juice.

A beautiful and excellent dessert pear; in season from November to January.

The tree is of upright habit, vigorous, and an early as well as great bearer, succeeding as a standard. Although it blossoms early, yet it withstands the late spring frosts better than most other sorts. It is a German variety, and most probably originated in Northern Saxony. It is called the Trout Pear from its being speckled like a trout.

31. GANSEL'S BERGAMOT—syn. Brocas Bergamot, Ives's Bergamot, Bergamotte d'Angleterre, Bonne Rouge, Diamant, Gurle's Beurré, Staunton.—*Shoots* rather short, moderately strong, light brown, rather thickly sprinkled with pale brown specks, which are mostly linear, downy at the extremities. *Leaves*

small, ovate, cordate at the base, obtusely crenated, the young ones downy. It is a remarkable characteristic of this sort that the spur leaves, instead of being longer and more elliptic than those of the shoots, are, on the contrary, small and heart-shaped. *Fruit* middle-sized or rather large, obovate, much flattened at the crown, regularly formed. Eye large, open, placed in a wide, shallow depression. Stalk thick and short, being scarcely ½ inch in length. Skin somewhat rough to the touch, grayish brown, tinged with dull yellow, and reddish brown next the sun, sometimes sprinkled with russet spots. Flesh white, buttery, a little gritty near the core, moderately juicy, very rich, sugary, and high flavoured.

A dessert pear of the highest excellence; in season in October and November. Although many pears have smoother flesh, yet in point of rich flavour very few can compete with it.

The tree is occasionally a shy bearer, but in good seasons and well managed, it generally bears well.

The variety was raised about the year 1768, from a seed of the Autumn Bergamot, by Lieut.-general Gansel, at Donnelland Hall, near Colchester.

32. GLOU MORCEAU—syn. Beurré de Cambron, Beurré d'Hardenpont, Beurré d'Hiver Nouvelle, Colmar d'Hiver, Glout Morceau, Gloux Morceaux, Got Luc de Cambron, Hardenpont d'Hiver, Hardenpont's Winter Butterbirne, Knonprinz Ferdinand, Krouprinz Ferdinand von Oestreich, Linden d'Automne, Roi de Wurtemberg, Stück.—*Shoots* vigorous, dark olive, rather thinly sprinkled with small, not very conspicuous spots. *Leaves* middle-sized, ovate-oblong, waved on the margin, crenated, near the extremities of the shoots sharply serrated. *Petioles* about ¾ inch in length. *Fruit* large, oblong-obovate, obtusely angular towards the eye. Eye middle-sized, open, with the segments of the calyx partly reclining on the sides of a rather deep, but not wide hollow. Stalk 1 inch in length, inserted in a small, obtusely angular cavity. Skin greenish brown, dotted and sprinkled with russet, becoming at maturity of a pale yellowish brown. Sometimes, in fruit from standards, it is mostly covered with brown russet, but where not russeted, it is not glossy but feels a little rough. Flesh white, exceedingly smooth and buttery, melting, rich, juicy, and sweet.

A dessert pear of the highest excellence; in season from November or December till January or February.

The tree is tolerably hardy, and an abundant bearer, succeeding as a standard in the southern parts of England. It also grows and bears well as an espalier.

The variety was raised at Mons, in Belgium, by the Abbé d'Hardenpont, about the year 1759.

33. GREEN PEAR OF YAIR—syn. Green Yair.—*Shoots* vigorous, of a clear reddish brown, thickly sprinkled with oblong specks of a whitish or pale brown colour. *Leaves* rather small, ovate, cordate at the base, tapering to the point, crenated. *Petioles* short. *Fruit* rather below the middle size, obovate, tapering to the stalk. Eye open, set in a shallow depression. Stalk short, moderately thick, rather obliquely inserted. Skin green, slightly sprinkled with russet. Flesh greenish, crisp, juicy, very sweet and pleasant.

A dessert pear; ripe in September.

The tree is vigorous, hardy, and a good bearer, suited for northern situations, where it may be grown as a standard.

34. HACON'S INCOMPARABLE—syn. Downham Seedling, Hacon's Norfolk Incomparable.—*Shoots* moderately vigorous, somewhat twisted, of an olive colour, thinly and rather obscurely spotted. *Leaves* scarcely middle-sized, somewhat cordate, slightly acuminate, finely serrated or acutely dentate. *Petioles* $\frac{3}{4}$ inch in length. *Fruit* large, roundish. Eye large, open, set in a shallow depression. Stalk of medium length and thickness, inserted in a moderately deep cavity. Skin somewhat rough, pale yellowish brown, slightly russeted. Flesh yellowish white, buttery, melting, juicy, rich, and sweet.

A very excellent dessert pear; in season from the end of November till January.

The tree is moderately vigorous, of a rather pendulous habit, hardy, and a great bearer, succeeding well as an orchard standard in the southern parts of England, but requiring a wall in the northern parts of the kingdom.

The variety originated at Downham-Market, in Norfolk.

35. HESSEL—syn. Hazel Pear.—*Branches* pendulous. *Shoots* slender, purplish brown. *Leaves* small, oval or elliptic, slightly serrated. *Petioles* slender, upwards of 1 inch in length. *Fruit* below the middle size, roundish obovate, with a slight projection on one side of the

stalk. Eye small, somewhat open, set in a shallow depression. Stalk about 1 inch in length, rather slender. Skin yellowish green, speckled with brown russet, and entirely covered with russet near the stalk. Flesh yellowish white, juicy, sugary, and rich, but gritty near the core.

A very good dessert pear; in season during September.

The tree is small, with pendulous branches, and is a most abundant bearer, on which account it is much cultivated for supplying the London markets.

36. JARGONELLE OF THE ENGLISH—syn. Beau Présent, Epargne, Grosse Cuisse Madame, Frauenschenkel, Poire des Tables des Princes, Saint Lambert, Saint Sampson, Sweet Summer.—*Shoots* very long, and remarkably vigorous, of a reddish colour, yellowish green where shaded, thinly sprinkled with yellowish brown spots. *Leaves* rather large, ovate, acuminate, doubly and finely serrated, woolly when young. *Petioles* long. *Flowers* very early and large. *Petals* roundish, imbricated. *Fruit* large, pyriform. Eye small, open, the segments of the calyx long and projecting. Stalk long, generally a little curved, not sunk at its insertion. Skin smooth, greenish yellow on the shaded side, tinged with red next the sun. Flesh yellowish white, a little gritty at the core, but melting, very juicy, rich, and excellent.

One of the best of the early dessert pears; ripe about the middle of August, but only keeping good for a few days.

The tree is vigorous, with a straggling, pendulous habit of growth, and a great bearer, either as a standard or upon a wall.

37. JEAN DE WITTE.—*Shoots* olive brown, buds short and downy. *Leaves* middle-sized, ovate, slightly serrated. *Petioles* slender, rather more than 1 inch in length. *Fruit* middle-sized, obovate. Eye very small, close, set in a slight depression. Stalk rather slender, scarcely 1 inch in length. Skin green, becoming pale green at maturity, sprinkled with small brown dots. Flesh yellowish white, buttery, melting, sweet, and rich, with a flavour somewhat resembling that of the Glou Morceau. In season from January to March.

The tree is hardy, and a good bearer as a standard.

The variety is highly deserving of cultivation, as it comes into use when the really good pears are becoming scarce.

38. JERSEY GRATIOLI—syn. Norris's Pear.

— *Shoots* strong, short, erect, dull yellowish brown, moderately sprinkled with not very conspicuous dots, downy. *Leaves* rather large, ovate-oblong, tapering to the point, crenated. Petioles above 1 inch in length. *Fruit* middle-sized, sometimes rather large, roundish, regularly formed. Eye large, open, set in an even, shallow depression. Stalk about $\frac{1}{2}$ inch in length, thick. Skin pale brown, sprinkled with russet specks. Flesh yellowish white, tender, melting, very sweet, and rich.

A most excellent dessert pear; in use during October.

The tree is vigorous and a good bearer, succeeding as a standard in the south of England.

39. KNIGHT'S MONARCH. — *Shoots* slender, yellowish olive, sprinkled with a considerable number of pale dots. *Leaves* small, ovate, slightly acuminate, very slightly crenated. Petioles slender, about 1 inch in length. *Fruit* middle-sized, obovate, sometimes roundish or even oblate. Eye small, open, set in a shallow depression. Stalk very short and thick, but sometimes rather slender, very little and occasionally not at all sunk at its insertion. Skin yellowish brown, tinged with red next the sun, the whole surface strewn with numerous, roundish, pale gray specks. Flesh yellowish white, buttery, melting, juicy, very rich and sweet, with an agreeable, slightly musky flavour.

A delicious dessert pear; in use during January.

The tree is vigorous, hardy, healthy, and an abundant bearer as a standard. It is inclined to bear in clusters at the extremities of the branches.

The variety was raised by Mr. Knight.

40. LOUISE BONNE (of Jersey)—syn. Beurré or Bonne Louise d'Araudoré, Bonne de Longueval, Louise Bonne d'Avranches, William the Fourth.—*Shoots* long, moderately vigorous, dark purplish brown, with numerous distinct spots. *Leaves* middle-sized, ovate-oblong, tapering to the point, doubly and rather sharply serrated. Petioles from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length. *Fruit* large, pyriform. Eye middle-sized, open, set in a small, shallow, evenly rounded depression. Stalk of medium length, curved, scarcely sunk at its insertion. Skin smooth, on the shaded side green at first, changing to greenish yellow when fully ripe; brownish red, thickly sprinkled with pale brown dots on the side next the sun. Flesh

whitish, buttery, melting, juicy, very sugary, rich, and high flavoured.

A most excellent dessert pear; in season during October.

The tree is of upright habit, hardy, vigorous, and a good bearer, succeeding as a standard.

The variety originated at Avranches, in Normandy.

41. MARCH BERGAMOT.—*Shoots* slender, olive yellow, sprinkled with pale brown dots, often prickly. *Leaves* small, ovate, slightly acuminate, irregularly and acutely crenated. Petioles slender, about 1 inch in length. *Fruit* middle-sized, roundish, depressed at the eye and stalk. Eye large, open, with the segments of the calyx projecting. Stalk thick, about $\frac{3}{4}$ inch long. Skin yellowish brown, partially covered with russet. Flesh yellowish white, buttery, a little gritty near the core, very rich and excellent.

A valuable late-keeping dessert pear; in season from February till April.

The tree is hardy, and a good bearer as a standard.

The variety was raised by Mr. Knight.

42. MARIE LOUISE—syn. Braddick's Field Standard, Forme de Marie Louise, Maria, Marie Chrétienne, Princesse de Parme.—*Shoots* long and moderately strong, inclined to be a little twisted, olive brown where exposed, sprinkled with numerous yellowish brown dots. *Leaves* middle-sized, oval, sometimes ovate, acuminate, sharply serrated, except near the base, which is nearly entire. Petioles of medium length. *Fruit* large, oblong, tapering, but obtuse at the stalk. Eye small, partially open, set in a shallow depression, beyond which the segments of the calyx project. Stalk long, of medium thickness, obliquely attached, and having frequently a projection of the fruit on one side. Skin smooth to the touch, green at first, changing, when fully ripe, to pale brownish yellow, mostly covered with soft russet. Flesh white, buttery, melting, very juicy, sweet, and rich.

A dessert pear of the highest excellence; in use during October and November, but, when grown in some soils and situations, keeping good till January.

The tree is healthy, vigorous, and an abundant bearer, succeeding well upon the quince stock and as a standard, from which, or from an espalier, the fruit is best flavoured. It will also succeed on a north wall in the southern

part of the kingdom; but it requires the protection of a wall with a warm aspect in the north.

The variety is of Belgian origin, and was raised by the Abbé Duquesne, in 1809. It should find a place in every collection.

43. NAPOLEON—syn. Archiduc Charles, Belle Canaise, Beurré d'Antein, Beurré Napoléon Bonaparte, Bon Chrétien Napoléon, Captif de Saint-Hélène, Charles X., L'Empereur, Gloire de l'Empereur, Liart, Médaille, Médaille d'Or, Napoleon's Butterbirne, Roi de Rome, Sucrée Dorée, Wurtemberg.—*Shoots* strong, olive green, sprinkled with numerous, well defined, pale brown spots. *Leaves* broad, ovate, tapering to the point, widely but not deeply serrated. *Petioles* of medium length and thickness. *Flowers* very large, late. *Petals* obovate. *Fruit* large, obtusely pyriform, broad and slightly angular at the eye, contracted near the middle, and truncated at the stalk. *Eye* large, open, set in a shallow depression. *Stalk* thick, rather more than 1 inch in length, inserted in a shallow cavity. *Skin* smooth, green at first, changing, when fully ripe, to a pale yellowish green. *Flesh* whitish, melting, not very fine, with an extraordinary abundance of rich, saccharine juice.

A delicious, melting pear; in use during November and sometimes partly in December.

The tree is vigorous, and a good bearer as a standard against a wall, and as a dwarf upon the quince stock. It is better flavoured grown as a dwarf or espalier, than against a wall, where, if not well exposed, its juice is too watery.

The variety was raised in 1808, by M. Liart, of Mons.

44. NEILL—syn. Colmar Bosc.—*Shoots* very strong, reddish, sprinkled with pale brown spots. *Leaves* middle-sized, oval, serrated. *Petioles* of medium length. *Fruit* very large, obovate. *Eye* large, open, placed in a shallow depression. *Stalk* generally short and rather thick, set in a small cavity. *Skin* pale yellow, sprinkled with light russet. *Flesh* white, buttery, melting, sweet, and very agreeable.

A large, handsome, and, when well ripened, almost first-rate dessert pear, becoming fit for use in September and October.

The tree is vigorous, healthy, and an extraordinary bearer, succeeding well as a standard in the southern parts of the kingdom.

The variety was raised by Van Mons, and named after Dr. Neill, of Edinburgh.

45. NE PLUS MEURIS.—*Shoots* strong, rather short-jointed, olive, sprinkled with gray specks. *Leaves* middle-sized, elliptic, tapering regularly to both extremities, finely serrated. *Petioles* about 1 inch in length. *Flowers* large. *Petals* oval, very little imbricated. *Fruit* middle-sized, roundish or roundish obovate, but very irregularly formed, with large rounded projections. *Eye* large, open. *Stalk* very short and thick. *Skin* brownish yellow, partially covered with russet. *Flesh* yellowish white, buttery, melting, juicy, and rich.

A most excellent dessert pear; in season from January to March.

The tree is of upright habit, hardy, and an abundant bearer in the warmer parts of England at least. The fruit often grows in compact clusters.

The variety was raised by Dr. Van Mons, and named after his gardener Meuris.

46. PASSE COLMAR—syn. Passe Colmar Gris, Passe Colmar Gris dit Précel, Passe Colmar Épineux, Chapman's Colmar, Colmar Doré, Colmar Épineux. Colmar Gris, Colmar Hardenpont, Colmar Preul, Colmar Souverain, D'Ananas, Beurré d'Argenson, Beurré Colmar Gris dit Précel, Cellite, Chapman's, Fondante de Mons, Fondante de Panisel, Gambier, König von Baiern, Marotte Sucrée Jaune, Précel, Présent de Malines, Regentin, Souveraine.—*Shoots* long, straight, moderately strong, of a fine clear olive yellow, sprinkled with small pale brown spots. *Leaves* rather small, oval, tapering to each end, nearly flat, finely serrated. *Petioles* of medium length, rather slender. *Fruit* middle-sized, obovate or obtusely pyriform, broad and flattened at the eye, with sometimes longitudinal furrows proceeding from the stalk. *Eye* rather large, open, set in a slight depression. *Stalk* of medium length and thickness, obliquely attached. *Skin* greenish brown at first, becoming yellowish when fully ripe, sprinkled with russet, and tinged with red next the sun when well exposed. *Flesh* yellowish white, buttery, melting, juicy, very sugary and rich, with a slightly aromatic flavour.

A highly esteemed dessert pear; in use during December and January, and sometimes tolerably good in February.

The tree is moderately vigorous, healthy, and a great bearer, either upon the pear or quince stock, against a wall or as a standard. It is well adapted for dwarf and espalier training; but in whatever mode the tree is trained,

care should be taken to shorten the shoots to a sufficient extent, as they have a great tendency to grow long and slender, becoming too weak, and overbearing themselves.

The variety is of Belgian origin, having been raised at Mons by M. Hardenpont.

47. RED DOYENNÉ—syn. Gray Doyenné, Dean's Gray, Gray Butter Pear, Doyenné d'Automne, Doyenné Galex, Doyenné Gris, Doyenné Rouge, Doyenné Roux, Saint-Michel Doré, Rothe Dechantsbirne, Rothe Herbst-butterbirne, Red Beurré and Beurré Rouge of some.—*Shoots* rather short, of medium vigour, greenish gray where shaded, reddish chestnut where exposed, thinly sprinkled with small pale brown dots. *Leaves* small, elliptic, tapering to the point, finely but not deeply toothed. *Petioles* very slender, about 1 inch in length. *Flowers* rather early, small. *Petals* oval, inclining to obovate. *Fruit* middle-sized, obovate. *Eye* small, closed by the converging points of the calyx, set in a shallow depression. *Stalk* about $\frac{1}{2}$ inch long, curved, very thick, set in a rather deep cavity, with a projection on one side. *Skin* covered with bright cinnamon-coloured russet, becoming of a bright red as the fruit approaches maturity. *Flesh* white, melting, buttery, sweet, and rich, with a cinnamon flavour.

A handsome and excellent dessert pear; in use during October and November, succeeding the White Doyenné, over which it has the advantage of keeping longer.

The tree is moderately vigorous, healthy, and a most abundant bearer, either upon the pear or quince stock.

48. SAINT-GERMAIN—syn. Saint-Germain Gris, Saint-Germain Jaune, Inconnue-la-Fare.—*Shoots* rather slender, olive yellow, moderately sprinkled with small dots. *Leaves* middle-sized, elliptic, folded, rather sharply serrated. *Petioles* fully 1 inch in length. *Fruit* large, oblong, widest at two-thirds of its length from the stalk. *Eye* small, open, set in a shallow depression, sometimes nearly prominent. *Stalk* of medium length, obliquely inserted. *Skin* yellowish green, sprinkled with brown russet next the sun. *Flesh* yellowish white, rather gritty, but very juicy, sweet, and rich.

A dessert pear, formerly in much esteem for its abundant, refreshing juice; in use from November to January.

The tree is a good bearer, but requires a wall.

49. SHOB DEN COURT.—*Shoots* small and short, olive brown towards the extremities, of

a chestnut colour next the sun, thinly and obscurely spotted. *Leaves* very small, roundish oval, shortly and abruptly acuminate, slightly serrated. *Petioles* 1 inch or more in length, very slender, deeply tinged with red. *Fruit* middle-sized, obovate. *Eye* middle-sized, open, set in a shallow depression. *Stalk* of medium length, inserted in a small cavity. *Skin* yellowish russet. *Flesh* yellowish white, buttery, melting, rich, and high flavoured.

An excellent dessert pear; in use during January and February.

The tree is hardy, vigorous, thorny when young, and a good bearer.

This variety was raised by Mr. Knight.

50. ROUSSELET DE RHEIMS—syn. Rousselet, Rousselet Petit.—*Shoots* long and strong, dark violet, thickly set with round dots. *Leaves* middle-sized, ovate, shortly acuminate, finely serrated. *Petioles* from $\frac{3}{4}$ inch to 1 inch in length. *Fruit* small, pyriform, or obovate, rounded at the top, obtuse at the stalk. *Eye* open, with the segments of the calyx rather prominent. *Stalk* from $\frac{1}{2}$ inch to 1 inch in length, of medium thickness. *Skin* brownish green, almost entirely covered with russet, next the sun dark brownish red, interspersed with yellowish brown specks. *Flesh* yellowish, tender, and melting, with an exceedingly rich and honied flavour.

A delicious dessert pear, which dries well; it is ripe in September.

The tree is vigorous, and an abundant bearer as a standard.

51. SECKEL—syn. New York Red Cheek, Red Cheeked Seckel, Shakspeare.—*Shoots* short and stout, reddish brown, thinly sprinkled with whitish or pale brown dots. *Leaves* rather large, ovate, tapering to the point, crenated or slightly serrated. *Petioles* about 1 inch in length. *Flowers* small, disposed in clusters at the ends of the shoots. *Petals* obovate, tapering to the claw, when expanding of a bright rose colour. *Fruit* small, obovate. *Eye* small, open, rather prominent. *Stalk* short, inserted in a very small cavity. *Skin* olive brown on the shaded side, deep red on the side next the sun, becoming of a brighter colour after gathering; the whole sprinkled with pale specks, which are most conspicuous on the sunny side, also with numerous dark-coloured dots. *Flesh* yellowish white, buttery, melting, juicy, and rich, with a honied sweetness and highly aromatic, musky, but very agreeable flavour.

A most delicious dessert pear; ripe about the end of October, but only keeping good a few days.

The tree is healthy, vigorous, hardy, and a great bearer as a standard.

52. SUFFOLK THORN.—*Shoots* small, short, but of firm growth, often thorny, light olive brown, with few spots. *Leaves* small, ovate, somewhat acuminate, near the base of the shoot cordate and acuminate. Petioles rather slender, little more than 1 inch in length. *Fruit* middle-sized, roundish. Eye tolerably large, open, set in a shallow depression. Stalk short, inserted in a shallow cavity. Skin yellowish brown, sprinkled with russet. Flesh white, tender, somewhat gritty near the core, but rich and excellent, partaking somewhat of the flavour of Gansel's Bergamot.

A most excellent dessert pear; ripe about the beginning of October.

The tree is hardy; its branches are sometimes thorny, or have sharp-pointed twigs and fruit-spurs. It is an abundant bearer as a standard.

The variety was raised from a seed of Gansel's Bergamot, by Andrew Arcedeckne, Esq., of Glevering Hall, Wickham-Market, Suffolk.

53. SUMMER FRANC RÉAL—syn. Franc Réal d'Été, Franc Royal d'Été, Beurré d'Août Ronde, Beurré Hatif, Franse Caneel-peer, Gros Micet d'Été.—*Shoots* strong, yellowish brown, sprinkled with a few pale brown dots. *Leaves* large, ovate, somewhat cordate at the base, acuminate, entire, very woolly when young. Petioles long, rather slender. *Fruit* middle-sized, irregularly obovate. Eye partially open, set in a moderately deep cavity. Stalk very short and thick, a little sunk at its insertion. Skin pale yellowish green, sprinkled with brown russet. Flesh white, buttery, melting, juicy, and rich.

A dessert pear; in season during the first fortnight of September.

The tree is vigorous, healthy, hardy, and an abundant bearer, succeeding as a standard or dwarf, either on the pear or quince stock.

54. SWAN'S EGG.—*Shoots* moderately vigorous, short-jointed, of a bright chestnut colour, strewed with obscure, small brownish dots. *Leaves* middle-sized, ovate, acuminate, sharply but not deeply serrated. *Fruit* rather below the middle size, obovate or roundish oval. Eye large, open, prominent. Stalk long, slender, inserted in a slight depression. Skin yellowish green, sprinkled with numerous green

specks and russet spots, frequently tinged with brownish red next the sun. Flesh white, melting, moderately juicy, and sweet, with a very pleasant flavour.

A favourite dessert pear; in season during October.

The tree is of upright habit, hardy, a good bearer as a standard, and extensively cultivated as such.

55. THOMPSON'S.—*Shoots* vigorous, olive yellow, slightly spotted. *Leaves* middle-sized or rather large, ovate, tapering to the point, with moderately sharp serratures. Petioles about $\frac{3}{4}$ inch long. At young fruit-spurs the leaves are long, narrow, elliptic, with long petioles. *Fruit* middle-sized, 3 inches long, and $2\frac{3}{4}$ inches broad at the widest part. Eye middle-sized, open, in a small cavity, the segments of the calyx projecting, a little recurved at the apex. Stalk small, about $\frac{1}{2}$ inch long, inserted in a small cavity with the fruit projecting most on one side. Skin pale yellow, with a tinge of brown next the sun, occasionally sprinkled with slight, thin russet. Flesh white, buttery, very melting and juicy, exceedingly rich and sugary.

A delicious dessert pear; in use during November.

The tree is vigorous, healthy, and a good bearer.

The variety is a seedling from the collections of Dr. Van Mons.

56. URBANISTE—syn Beurré Picquery.—*Shoots* moderately strong, of an olive colour, thinly sprinkled with pale gray specks.—*Leaves* middle-sized, oval, acuminate, finely serrated. Petioles upwards of 1 inch in length, rather slender. *Flowers* rather below the middle-size. Petals oval, tapering to the claw, not imbricated when fully expanded. *Fruit* middle-sized, obovate. Eye small, open, set in a narrow, evenly rounded depression. Stalk of medium length, rather thick, a little sunk at its insertion. Skin smooth, soft, greenish brown, slightly russeted. Flesh white, very buttery, melting, juicy, sweet, and rich, with a slight perfumed flavour.

A dessert pear of the highest excellence; in use during October.

The tree is moderately vigorous, healthy, and a good bearer, succeeding as a standard, dwarf, or espalier, and the fruit so produced is of much higher flavour than that ripened upon a wall.

The variety was found by the Comte de

Coloma, in the garden of a convent at Mechlin.

57. VAN MONS-LÉON LECLERC—*Shoots* moderately vigorous, olive, with a slight tinge of gray, sprinkled with numerous, small, gray dots. *Leaves* scarcely middle-sized, oval, with a long tapering point, slightly crenated. *Petioles* slender, 1 inch or more in length. *Fruit* large, oblong. Eye small, open, set in a shallow depression. Stalk about 1 inch in length. Skin pale brownish yellow, partially covered with cinnamon russet. Flesh yellowish white, buttery, melting, juicy, rich, and excellent.

A most excellent dessert pear; in use in October and November.

The tree is moderately vigorous, and a good bearer on the pear stock, but will not succeed on the quince.

58. WHITE DOYENNÉ—syn. Bcurré Blanc, White Beurré, White Autumn Beurré, Butter Pear, Dean's, Doyenné Blanc, Pine Pear, Poire à Courte Queue, Bonne-ente, Citron de Septembre, De Limon, Monsieur, Neige, St. Michel, De Seigneur, Snow Pear, Valencia, Virgalieu, Warwick Bergamot, Dechantsbirne, Kaiserbirne, Kaiser d'Automne, Weisse Herbstbutterbirne.—*Shoots* moderately vigorous, light brown, tinged with chestnut where exposed, sprinkled with pale brown spots. *Leaves* small, oval, folded, recurved, slightly and regularly serrated. *Petioles* about 1 inch in length, slender, of a whitish colour. *Fruit* middle-sized, obovate, depressed at the eye and stalk. Eye small, closed by the converging points of the calyx, set in a shallow depression. Stalk very short and thick, a little sunk at its insertion. Skin whitish or pale yellow, and from a standard sprinkled more or less with cinnamon russet. Flesh white, very buttery, melting, juicy, rich, and excellent.

A very good dessert pear; in use from the end of September till the end of October.

The tree is moderately vigorous when young, but when old it is apt to canker, and the fruit then cracks. It is a great bearer, succeeding well either upon the pear or quince stock.

59. WILLIAMS'S BON CHRÉTIEN—syn. Bartlett, Williams's.—*Shoots* vigorous, olive-coloured, light chestnut where well exposed, marked with few, not conspicuous brown spots. *Leaves* middle-sized, of thick substance, ovate with a tapering point, regularly and finely serrated. *Petioles* about $\frac{3}{4}$ inch long. *Fruit* large, obtusely pyriform, angular near the eye, which is small, nearly closed, prominent or

set in a very shallow depression. Stalk short, thick, obliquely inserted in a small, angular cavity. Skin greenish yellow, becoming pale yellow when ripe, thickly strewed with small green spots, tinged with red next the sun when well exposed. Flesh white, buttery, melting, juicy, sweet, and perfumed.

A very good early dessert pear; in use from the end of August till the middle of September.

The tree is a strong grower, and a good bearer as a standard. The fruit should be gathered a little before it parts readily from the tree, otherwise it is not so juicy, and its flavour is too musky.

60. WINDSOR—syn. Konge, Summer Bell of some.—*Shoots* strong, erect, dark brown, thinly sprinkled with dull brown spots. *Leaves* large, roundish oval, somewhat acuminate, toothed or acutely crenated. *Petioles* about 1 inch in length, strong. *Fruit* large, pyriform. Eye small, partially open, prominent. Stalk upwards of 1 inch in length, of medium thickness. Skin smooth, yellowish green where shaded, becoming pale yellow when fully ripe, and having a blush of red next the sun. Flesh yellowish white, buttery, melting, juicy, and sweet.

A handsome dessert pear; ripe in the end of August and beginning of September.

The tree is remarkably upright in its habit, vigorous, and a moderate bearer, but apt to canker in cold soils.

61. WINTER NELIS—syn. Nelis d'Hiver, Beurré de Malines, Bonne de Malines, Etournean, La Bonne Malinaise, Malinaise, Cuvelier.—*Shoots* rather slender, of a darkish yellow, and sprinkled with small pale brown dots. *Leaves* middle-sized, very narrow, elliptical, tapering to the point, or almost entire. *Petioles* long and slender. *Fruit* middle-sized, turbinate. Eye large, open, set in a shallow depression. Stalk long, of medium thickness, inserted in a small cavity. Skin yellowish green, much speckled, and sometimes almost entirely covered with dark brown russet. Flesh yellowish white, buttery, melting, with a very rich, high-flavoured, saccharine juice.

A most excellent winter dessert pear; in use during December and January.

The tree is not a strong grower, but a good bearer as a standard in the south of England. It requires a wall farther to the north, and in cold localities it may even be allowed a place on a south wall.

The variety was raised by M. Nelis.

II.—KITCHEN PEARS.

62. BEQUÊNE MUSQUÉ.—*Shoots* moderately vigorous, brown, slightly spotted. *Leaves* rather small, elliptical, slightly serrated. *Petioles* about 1 inch in length, slender. *Fruit* middle-sized, oblong, tapering slightly towards the stalk. *Eye* small, open, prominent. *Stalk* long, slender, inserted in a small cavity. *Skin* pale yellow, sprinkled with numerous brown dots, sometimes slightly tinged with brownish red next the sun. *Flesh* yellowish white, and crisp, with a perfumed, rather disagreeable flavour.

A stewing pear of great merit; in use from November to January.

The tree is tolerably hardy, and a great bearer, succeeding as a standard.

63. BEZI D'HÉRI—syn. Bezi Royal, De Bordeaux.—*Shoots* moderately strong, reddish brown, strewn with pale brown dots. *Leaves* middle-sized, ovate, acuminate, slightly crenated, almost entire. *Petioles* $\frac{3}{4}$ inch in length. *Fruit* middle-sized, roundish, inclining to oval. *Eye* open, set in a very slight depression. *Stalk* rather long, slender. *Skin* greenish yellow, speckled with brown, tinged with red next the sun. *Flesh* white, firm, crisp, and sweet, with an anise flavour.

An excellent stewing pear; in use from October to January.

The tree is a very abundant bearer as a standard.

64. CATILLAC—syn. Bell Pear, Cadillac, Grand Monarque, Groote Mogul, Katzenkopf, Pound Pear and Poire de Livre of some.—*Shoots* very strong, slightly downy, brown, reddish brown next the sun, sprinkled with numerous, not very conspicuous ash-coloured spots. *Leaves* very large, broad oval, abruptly acuminate, of thick substance, downy. *Petioles* about 1 inch in length. *Fruit* very large, broadly turbinate, projecting more to one side of the core than to the other. *Eye* small, open, in a wide, rather deep hollow. *Stalk* thick, about 1 inch long, inserted somewhat obliquely in a small cavity. *Skin* yellowish brown. *Flesh* yellowish white, hard, crisp, rather gritty, with an astringent juice.

An excellent baking pear, and although more gritty than some others, much esteemed for stewing; its pulp by that process acquiring a fine red tinge. It may be used from December to April.

The tree is hardy, vigorous, and a good

bearer as a standard. It does not succeed on the quince stock.

65. CHAPTAL.—*Shoots* short, very stout, dull chestnut brown, moderately sprinkled with spots of light brown, which are not very conspicuous, from their colour approaching that of the shoot in general. *Leaves* middle-sized, roundish ovate, somewhat acuminate. *Petioles* short, about $\frac{1}{6}$ ths of an inch in length. *Fruit* large, obovate. *Eye* open, inserted in a small cavity, on the sides of which the segments of the calyx are reflexed. *Stalk* scarcely 1 inch in length, of medium thickness. *Skin* greenish brown, speckled and sometimes nearly covered with cinnamon brown. *Flesh* yellowish white, firm, tolerably juicy and sweet, with a slight perfume.

A very good kitchen pear; in use from December to April.

The tree is vigorous, healthy, and a very good bearer.

66. FRANC RÉAL D'HIVER—syn. Franc Réal, Fin-Or d'Hiver.—*Shoots* moderately vigorous, brownish yellow, strewn with numerous distinct spots. *Leaves* oblong, tapering to the point, entire or slightly crenated, woolly. *Petioles* of medium length. *Fruit* middle-sized, roundish obovate. *Eye* small, open, set in a shallow depression or level with the top. *Stalk* slender, about 1 inch in length, inserted in a small cavity. *Skin* yellow, strewn with numerous spots of brown russet. *Flesh* whitish, crisp, coarse, and rather dry, but sweet.

An excellent kitchen pear, which on stewing becomes tender and acquires a light purple colour; in season from December to March.

The tree is a good bearer, and succeeds as a standard.

67. FLEMISH BON CHRÉTIEN—syn. Bon Chrétien Nouvelle, Bon Chrétien Turc.—*Shoots* vigorous, bright yellowish brown, slightly spotted. *Leaves* middle-sized, ovate, tapering to the point, finely and sharply serrated. *Petioles* slender, fully 1 inch in length. *Fruit* large, obovate. *Eye* middle-sized, open, set in a shallow, evenly rounded depression. *Stalk* rather more than 1 inch in length, slightly curved, inserted by the side of a fleshy protuberance. *Skin* green at first, changing to a yellowish colour when fit for use, sprinkled with numerous russet spots on the shaded side, mottled and sometimes almost entirely covered with russet on the side next the sun. *Flesh* whitish, crisp, gritty near the core, sweet, and moderately juicy.

69. UVEDALE'S SAINT-GERMAIN—syn. Beauté de Tervueren, Belle Angevine, Belle de Jersey, Bolivar, Chambers's Large, Duchesse de Berry, German Baker, Grosse de Bruxelles, Lent Saint-Germain, Pickering Pear, Pickering's Warden, Royale d'Angleterre, De Tonneau, Union, Uvedale's Warden.—*Shoots* strong, somewhat downy, dark olive green, chestnut next the sun, sprinkled with numerous light gray dots. *Leaves* large, ovate, acuminate, entire or slightly dentate. *Petioles* upwards of 1 inch in length. *Fruit* very large, pyriform, being broad at the top, more or less con-

The tree is hardy, and an excellent bearer, succeeding as a standard.

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Table exhibiting the Months in which the Dessert Pears above described are generally in use—Continued.

NAME.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.
Eyewood,.....	*	*
Figue de Naples,.....	*
Flemish Beauty,.....	*	*
Fondante d'Automne,.....	*	*
Forelle,.....	*	*	*
Gansel's Bergamot,.....	*	*
Glou Morceau,.....	*	*
Green Pear of Yair,.....	*
Hacon's Incomparable,.....	*	*	*
Hessel,.....	*
Jargonelle (of the English),.....	...	*
Jean de Witte,.....	*	*
Jersey Gratioli,.....	*
Knight's Monarch,.....	*
Louise Bonne (of Jersey),.....	*
Mareh Bergamot,.....	*	*	*
Marie Louise,.....	*	*
Napoléon,.....	*	*
Neill,.....	*	*
Ne plus Meuris,.....	*	*	*
Passe Colmar,.....	*	*
Red Doyenné,.....	*	*	*
Rousselet de Rheims,.....	*
Saint-Germain,.....	*	*	*
Seckel,.....	*
Shobden Court,.....	*	*
Suffolk Thorn,.....	*
Summer Franc Réal,.....	*
Swan's Egg,.....	*
Thompson's,.....	*
Urbaniste,.....	*
Van Mons-Léon Leclerc,.....	*	*
White Doyenné,.....	*	*
Williams's Bon Chrétien,.....	...	*	*
Windsor,.....	...	*	*
Winter Nelis,.....	*	*

Table exhibiting the Months in which the Kitchen Pears above described are generally in use.

NAME.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.
Bequène Musqué,.....	*	*	*
Bezi d'Héri,.....	*	*	*
Catillac,.....	*	*	*	*	*
Chaptal,.....	*	*	*	*	*
Flemish Bon Chrétien,.....	*	*	*	*	*
Franc Réal d'Hiver,.....	*	*	*	*
Gilgil,.....	*	*	*
Uvedale's Saint-Germain,.....	*	*	*	*
Verulam,.....	*	*	*	*	*	*	*	...

In addition to the varieties already described, the following are also worthy of notice:—

BEADNELL'S SEEDLING.—Fruit middle-sized, turbinate. Eye a little open. Stalk short. Skin pale yellowish green on the shaded side, red intermixed with gray dots next the sun. Flesh perfectly melting, with an abundance of highly refreshing juice. In season in the end of September or beginning of October.

Tree vigorous, and an abundant bearer.

BELLE APRÈS NOËL.—Fruit middle-sized, bergamot-shaped. Eye placed in a large hol-

low. Stalk short and thick. Skin yellowish brown, red next the sun. Flesh melting, rich, and agreeably perfumed. Ripe in December and January.

BEZI DE CAISSOY.—Fruit small, roundish obovate. Eye open. Stalk about $\frac{1}{2}$ inch in length, inserted in a small, rather deep cavity. Skin yellowish green, sprinkled with russet. Flesh melting, buttery, and rich. In season from November till March.

BEURRÉ CLAIRGEAU.—Fruit large, pyriform, tapering to the stalk. Eye open, slightly sunk. Skin yellowish, sprinkled with brown

dots, and sometimes slightly coated with soft, olive brown russet. Flesh fine, buttery, and rich. Ripe in November. It partakes of the nature of the Beurré de Capiaumont. The tree is hardy, and a good bearer.

BERGAMOTTE ESPEREN.—Fruit large, resembling the Easter Beurré in appearance, but with a longer stalk. Flesh buttery and rich. In season from January till April.

BLANC PERNÉ.—Fruit large, obovate. Eye open, shallow, with the segments of the calyx projecting. Stalk upwards of 1 inch in length, rather slender. Flesh yellowish white, half melting and buttery, sugary, and tolerably rich. Ripe in April, and may be kept till June.

CHARLOTTE DE BRAUWER.—Fruit large, obovate, obtuse at the stalk, a little contracted below it. Eye small, closed by the segments of the calyx, in a moderately deep depression. Stalk short, thick, a little sunk at its insertion. Skin mostly covered with cinnamon-coloured russet. Flesh melting, rich, and sugary, with a flavour resembling that of the Beurré Dicel.

COLMAR D'AREMBERG.—Fruit middle-sized, or rather large, turbinate, or somewhat colmar-shaped. Eye deeply sunk. Stalk scarcely 1 inch in length, of moderate thickness, obliquely inserted. Skin greenish yellow, speckled with russet. Flesh melting, rich, and excellent. Ripe in November.

ESPEREN.—Fruit middle-sized, oblong obovate. Eye small, shallow. Stalk short. Skin pale yellow, tinged with red next the sun. Flesh white, buttery, perfumed, sugary, and rich. Ripe in October.

GANSEL'S LATE BERGAMOT.—Fruit smaller than Gansel's Bergamot, from which the variety was raised, but otherwise resembling that excellent and hitherto unequalled pear, as regards its peculiarly exquisite flavour; and it is in use two months later, or in December and January. The tree is vigorous, and bears as a standard.

HENRI QUATRE.—Fruit small, turbinate, flat at the crown. Eye small. Stalk about 1 inch in length. Skin dull greenish brown, reddish brown next the sun, interspersed with gray specks. Flesh yellowish white, melting, juicy, and very rich, with an aroma nearly equal to that of the Seckel. Ripe in September and October. The tree is a great bearer as a standard, and, although the fruit is not large, yet, for its rich aroma, a small tree of it may find a place in every good collection.

JOSEPHINE DE MALINES.—Fruit middle-sized, turbinate. Eye open, in a shallow depression. Stalk of medium length and thickness. Skin pale yellowish brown, tinged with red next the sun. Flesh melting, buttery, sugary, and rich. In season from January till March. A valuable late pear.

LANGELIER'S SEEDLING QUEEN VICTORIA.—Very much resembling the Glou Morceau. The flesh is melting, buttery, and exceedingly rich and sugary. Ripe in January.

NOUVEAU POITEAU.—Fruit rather large, obovate, tapering to the stalk, which is long, with a fleshy projection at its insertion. Eye small, open, slightly sunk. Skin pale green, sprinkled with brown dots. Flesh buttery, melting, with an abundance of rich, refreshing, slightly sub-acid juice. Ripe in October and November.

POMME POIRE.—Fruit middle-sized, oblate, concave at the eye and stalk; the former somewhat open. Stalk short. Skin speckled with brown, or occasionally covered with cinnamon-coloured russet. Flesh yellowish, buttery, melting, rich, and excellent, but a little gritty near the core. Ripe in the end of October and beginning of November.

PRINCE ALBERT.—Fruit middle-sized, obovate or pyriform. Eye small, open, placed in a shallow depression. Stalk of medium length and thickness. Skin yellowish brown, with russet specks. Flesh fine, melting, and buttery, with a richly sugared juice, partaking of the flavour of the Passe Colmar. A valuable late pear of the highest excellence; in season from February till April. The tree is healthy, vigorous, and highly deserving of cultivation.

SUCRÉE VERTE.—Fruit small or middle-sized, obovate. Eye open, shallow. Stalk about $\frac{3}{4}$ inch in length. Skin green, even when the fruit is fully ripe. Flesh greenish white, melting, juicy, sweet, and rich. Ripe in the end of October. The tree is vigorous, and a great bearer as a standard.

TRIOMPHE DE JODOIGNE.—Fruit large, turbinate. Eye open, set in a shallow depression. Skin mottled with yellow and cinnamon-coloured russet. Flesh yellowish white, melting, sugary, and delicious, with a rich, perfumed, vinous flavour. Ripe in November and December.

VIRGOULEUSE.—Fruit middle-sized, yellowish green. Flesh remarkable for its yellow tinge, melting, buttery, sometimes excellent. The variety is mentioned because it is one of

the sorts used for working on the quince, and being afterwards worked itself with any variety of pear that does not succeed when worked immediately on the quince stock.

ZÉPHIRIN GRÉGOIRE.—Fruit small, obovate, yellowish brown, sprinkled with russet. Flesh melting, buttery, rich, and sugary. An excellent pear; in season during November and December.

List of Varieties for Orchard Culture in England.

Althorp Crassane.	Jersey Gratioli.
Ambrosia.	Knight's Monarch.
Aston Town.	Louise Bonne (of Jersey).
Autumn Bergamot.	March Bergamot.
Bergamotte Cadet.	Marie Louise.
Beurré d'Amanlis.	Ne plus Meuris.
Beurré Bosc.	Passe Colmar.
Beurré de Capiaumont.	Red Doyenné.
Beurré Diel.	Rousselle de Rheims.
Beurré Rance.	Seckel.
Bishop's Thumb.	Shobden Court.
Broom Park.	Suffolk Thorn.
Burgermeester.	Summer Franc Réal.
Chaumontel.	Swan's Egg.
Citron des Carmes.	Thompson's.
Comte de Lamy.	Urbaniste.
Doyenné d'Été.	Williams's Bon Chrétien.
Elton.	Windsor.
Eyewood.	Winter Nelis.
Figue de Naples.	<i>Kitchen:—</i>
Flemish Beauty.	Bequène Musqué.
Fondante d'Automne.	Bezi d'Héri.
Forelle.	Catillac.
Green Pear of Yair.	Chaptal.
Hacon's Incomparable.	Flemish Bon Chrétien.
Hessel.	Verulam.
Jean de Witte.	

List of Sorts for Culture on Walls in England.

Beurré d'Aremberg.	Gansel's Bergamot.
Beurré Bosc.	Glou Morceau.
Beurré Diel.	Jargonelle.
Beurré Rance.	Louise Bonne (of Jersey).
Brown Beurré.	Napoléon.
Chaumontel.	Passe Colmar.
Colmar.	Saint-Germain.
Crassane.	Winter Nelis.
Duchesse d'Angoulême.	<i>Kitchen:—</i>
Easter Beurré.	Uvedale's St. Germain.
Forelle.	

Selection of Varieties for Cultivation as Dwarf Pyramids on the Quince Stock.

Bergamotte d'Esperen.	Easter Beurré.
Beurré Clairgeau.	Forelle.
Beurré d'Amanlis.	Glou Morceau.
Beurré d'Aremberg.	Jersey Gratioli.
Beurré de Capiaumont.	Louise Bonne (of Jersey).
Beurré Diel.	Passe Colmar.
Beurré Sterckmans.	Prince Albert.
Chaumontel.	Red Doyenné.
Citron des Carmes.	Urbaniste.
Comte de Lamy.	Williams's Bon Chrétien.
Duchesse d'Angoulême.	Winter Nelis.

List of Sorts for Cultivation on Espaliers.

Beurré d'Amanlis.	Knight's Monarch.
Beurré d'Aremberg.	Louise Bonne (of Jersey).
Beurré Bosc.	Marie Louise.
Beurré de Capiaumont.	Napoléon.
Beurré Diel.	Neill.
Beurré Rance.	Ne plus Meuris.
Chaumontel.	Passe Colmar.
Duchesse d'Angoulême.	Suffolk Thorn.
Easter Beurré.	Thompson's.
Figue de Naples.	Urbaniste.
Flemish Beauty.	Van Mons-Léon Leclerc.
Forelle.	Williams's Bon Chrétien.
Glou Morceau.	Winter Nelis.
Hacon's Incomparable.	<i>Kitchen:—</i>
Jean de Witte.	Catillac.

Selection of Varieties for a Cottage Garden.

Beurré Diel.	Louise Bonne (of Jersey).
Beurré Rance.	Passe Colmar.
Glou Morceau.	Williams's Bon Chrétien.

And if a stewing pear is required, the Verulam may be added.

Selection of Twelve Varieties.

Althorp Crassane.	Louise Bonne (of Jersey).
Beurré d'Amanlis.	Marie Louise.
Beurré Diel.	Passe Colmar.
Beurré Rance.	Thompson's.
Easter Beurré.	Williams's Bon Chrétien.
Glou Morceau.	Winter Nelis.

Selection of Twenty Varieties.

Althorp Crassane.	Jean de Witte.
Beurré d'Amanlis.	Knight's Monarch.
Beurré Bosc.	Louise Bonne (of Jersey).
Beurré de Capiaumont.	March Bergamot.
Beurré Diel.	Marie Louise.
Beurré Rance.	Ne plus Meuris.
Doyenné d'Été.	Passe Colmar.
Duchesse d'Angoulême.	Thompson's.
Easter Beurré.	Williams's Bon Chrétien.
Glou Morceau.	Winter Nelis.

Selection of Thirty Varieties.

Althorp Crassane.	Forelle.
Bergamotte Cadet.	Glou Morceau.
Beurré d'Amanlis.	Jean de Witte.
Beurré Bosc.	Knight's Monarch.
Beurré de Capiaumont.	Louise Bonne (of Jersey).
Beurré Diel.	March Bergamot.
Beurré Rance.	Marie Louise.
Broom Park.	Ne plus Meuris.
Comte de Lamy.	Passe Colmar.
Doyenné d'Été.	Seckel.
Duchesse d'Angoulême.	Suffolk Thorn.
Easter Beurré.	Thompson's.
Eyewood.	Van Mons-Léon Leclerc.
Figue de Naples.	Williams's Bon Chrétien.
Flemish Beauty.	Winter Nelis.

List of Varieties for Cultivation as Standards in Scotland.

Althorp Crassane.	Beurré de Capiaumont.
Aston Town.	Broom Park.

Chaumontel.	Green Pear of Yair.
Citron des Carmes.	Hessel.
Comte de Lamy.	Louise Bonne (of Jersey).
Doyenné d'Été.	Red Doyenné.
Elton.	Seckel.
Eyewood.	Suffolk Thorn.
Flemish Beauty.	Swan's Egg.
Forelle.	Williams's Bon Chrétien.

List of Varieties for Cultivation on Walls in Scotland.

Althorp Crassane.	Glou Morceau.
Autumn Bergamot.	Hacon's Incomparable.
Beurré d'Amanlis.	Jargonelle (of the English).
Beurré Bosc.	Knight's Monarch.
Beurré Diel.	Louise Bonne (of Jersey).
Beurré Rance.	Marie Louise.
Colmar.	Ne plus Meuris.
Crassane.	Passe Colmar.
Easter Beurré.	Suffolk Thorn.
Figue de Naples.	Thompson's.
Flemish Beauty.	Van Mons-Léon Leclerc.
Forelle.	Williams's Bon Chrétien.
Gansel's Bergamot.	Winter Nelis.

List of Perry Pears.

Barland.	Moorcroft.
Brown Huffcap.	Oldfield.
Green Huffcap.	Red Huffcap.
Holmore.	Yellow Huffcap.
Longland.	Teinton Squash.

All the above are of great excellence, and, with the exception of the last, abundant bearers.

Propagation.—This is effected by seed for obtaining new varieties and stocks, whilst the identical sorts may be multiplied by cuttings, layers, and inarching; but the best and most generally practised mode of doing so is by budding and grafting.

The manner of raising pear trees from seed is similar to that adopted in the case of the apple; and, therefore, the details of it need not be repeated. Sowing, with the view of obtaining new and improved varieties, has long been a favourite practice in Belgium; and the result has been a number of varieties of better quality and hardier than those formerly in cultivation. Many such were raised by Dr. Van Mons, of Louvaine; but the origin of some which rank among the finest has been traced to the gardens attached to religious establishments. M. de Jonghe, of Brussels, who has for forty years paid much attention to the cultivation of the pear tree, gives, in an article in the *Gardeners' Chronicle*, 1855, p. 55, various details respecting the choice of seeds, their preservation, time, and manner of sowing, more especially with the view of raising improved varieties. He remarks that "seedling varieties of pears vary infinitely in

successive generations. This truth is being continually proved by ocular demonstration. There is another principle connected with the above, which is, the more a type has entered into a state of variation, the greater is its tendency to continue doing so, and the more it has varied from the original type, the more it is disposed to vary still further." With this we entirely coincide; and, although we already possess varieties so excellent as to leave nothing further to be desired, yet for our climate greater hardiness still remains a desideratum. Seedlings can easily be raised, and some among them may possess that property in a high degree; for, if we compare the hardiest of many of these now cultivated in England and Belgium, with those which have been for ages and are now cultivated in Italy, it must be admitted that the pear tree has greatly varied in respect to hardiness; and, having done so, there is no proof that it will not vary still more in the same desirable direction. According to M. de Jonghe, the seeds should be taken from fruits produced by vigorous trees, worked on the pear stock. "When taken out of the cells the seeds should be put in a small jar, half filled with dry sand, with which the seeds should be mixed. The jars should be placed in the dark, where the seeds can neither dry nor rot. After remaining in this situation for a month or two, the seeds should be taken out and put in papers, each sort separately, marking the name or number of the variety of fruit from which the seeds were taken, together with the date of the ripening of the fruits. By keeping it in the way above-mentioned, the skin of the seed will acquire a consistence, and the kernel a firmness that will enable it to vegetate with greater vigour when committed to the soil, in the open air. I have seen pear seeds sown in garden pots, in wooden boxes, and on a gentle hot-bed; but from many years' experience I have found that it is preferable to sow the seeds in the open ground. They grow in the latter with the proper degree of vigour, and make a substantial growth. In September, a part of the garden is chosen which is not infested by any kind of insect. The ground is dug deeply, but not manured. It is carefully cleaned from all weeds, and at the same time the soil is made as fine as possible. About the end of the month drills are made 2 feet apart, and about 2 inches deep. After the bottoms of the drills have been levelled,

a thin layer of wood-ashes is sown in them. The seeds, preserved since the winter or spring, are steeped in a solution of sulphate of lime, and placed about 2 inches apart in the drills." The seeds are recommended to be placed with the thick end downwards, so that the radicle may proceed in that direction, and the plumule upwards without forming a curve at the base of the stem, as is the case when they are not properly placed. The seed-leaves will appear above ground towards the end of the following March.

Mr. Rivers details, in the *Journal of the Horticultural Society*, vol. ix. p. 292, a very good mode of raising pear trees from seed, and which might be advantageously adopted, more especially as it is calculated to prevent disappointment arising from the attacks of vermin and from the uncertainty of our springs. He says, "As soon as the pear-eating season commences, I have some two or three dozen 9-inch pots filled with a compost of loam and rotten manure, say two-thirds of the former to one-third of the latter; some sand added will improve it; these pots are then placed on bricks or tiles to keep out the worms, in some convenient situation (away from hedges, as they harbour slugs) near the house, and in each pot is a smooth slip of deal, painted, ready to be written on. I will assume it to be October; I am eating a fine specimen of the Louise Bonne pear; the pips are plump and brown. I take them from the core carefully, go to one of the pots of earth, and with my finger and thumb press in the pips one at a time, to about 1 inch deep, and level the surface with my hand. I then write on the label, say, 'Louise Bonne Pear, Oct. 1855;' a piece of slate or tile is then placed on the pot, so as to completely cover it and prevent the ingress of mice. A few days after this I may be again eating a Louise Bonne pear. I reserve the pips, remove the covering from the pot, and plant them with the others, and so repeat this till some fifteen pips are planted in one pot, which will raise quite enough trees from one variety. Again, it is February; I am at my dessert; a delicious Josephine de Malines pear gives me some fine pips; my pots of earth are frozen; I place them in paper, and write the name on it. I then have a pot of earth taken to the green-house, or, in default of such a structure, to the kitchen; plant the pips as above, write on the label, 'Josephine de Malines Pear, Feb. 1855;'

cover the pot as before directed, and place it out of doors; early in March the covers must be taken off; the young plants from the pips sown in the autumn will make their appearance early in March if the weather be mild; those from pips sown in February or March will not vegetate till April or May, and the pips sown in May will probably remain dormant till the following March. There are two methods of managing young pear seedlings; the first is the most simple, and well adapted for those whose hands are full of gardening matters; it is merely to let the pots stand on the bricks in full sunshine all the summer, giving them abundance of water; each young tree in the autumn will, or ought to be, from 12 to 18 inches in height, and its stem as thick as a quill, and well ripened; about the end of October, these seedlings may be planted out in the garden, in rows, 3 feet row from row, and 18 inches apart in the rows; and in March following, if there is a wish to bring them rapidly into bearing, each young seedling tree may be cut down to within 2 inches of its base, and one or two scions made from it (one ought to be enough, and that made from the lower part of the shoot); these should be grafted on to some stout stocks, or on to branches of a bearing tree; an excellent method is to buy at a nursery old dwarf pears without names at a cheap rate, to plant them out one year, and then to rind-graft them (this is to insert the grafts between the bark and the wood) with the seedlings. They should be headed down to a stump, 9 or 10 inches in height, in February. In April, the bark will part readily, and they may be grafted; they will soon make nice pyramidal trees, and by being removed biennially, they will come into bearing quickly, and not occupy much room; every sort should be labelled with its origin in this way—'From Marie Louise, Nov. 1854,' and so on; this labelling gives much interest to the culture of seedling pears; for while waiting six or seven years till they bear fruit, their habits will be found very interesting, and in most instances a strong family likeness to their parent may be distinguished in the leaves and shoots of the young trees, varied by now and then a puny, weakly youngster, which will canker and die in three or four years, and then by some one or two trees in ten showing a wide departure from the parental stock, making vigorous and thorny shoots, and growing

as much in one year as other members of the family in three, contrary to the views of parents and 'pastors and masters' in general; it is these runagates which give the liveliest hopes to the raiser of pears." "Thus far I have given the most simple method of raising seedlings by sowing in pots, and not transplanting them till the autumn. Another method is to place the pots in a gentle forcing house, either in January or February; the young plants will soon make appearance, and when they have made four leaves in addition to the seed leaves, they should be raised carefully, with all their fibres, and potted into 3-inch pots. As soon as these are full of roots they should be shifted into larger pots, and kept growing rapidly under glass till the beginning of June; they may then be planted out in rich light soil, and the probability is they will be 3 feet high by the autumn."

The pear tree may be propagated by cuttings, but the process is too slow to be recommended, and we only mention it as a means of securing a variety which might otherwise be lost through the failure of buds or grafts. Cuttings in such a case might be struck, so as to keep alive till a favourable opportunity occurred for working from them.

If it were desired to have trees on their own roots, layering might be resorted to. We are not aware, however, that there would be any advantage in this, for the wood of the cultivated varieties coincides well with that of the seedlings used as stocks.

Budding and grafting, as already observed, are the modes generally adopted for the propagation of the pear. Stocks, consisting either of the pear itself or of some allied species, are necessary before the propagation can take place, and these, accordingly, require to be first taken into consideration.

The *Pear Stock* is, unquestionably, the most natural for the pear; on it, consequently, the trees possess the greatest vigour, and attain the greatest age. They are reared from seeds, either of the wild pear or of the varieties cultivated for perry, as the seeds can be obtained in the greatest abundance from these sources. The seedlings are reared in the same way as apple stocks. In transplanting, those of a crooked habit, or which do not exhibit a free upright mode of growth, should be rejected. In the seed bed, some will be observed of taller growth than others; and after the first transplantation, a certain portion will again

take the start of others. When about to be finally planted out in rows for grafting or budding, the plants should be sized, so that all the plants in each row may be of equal height and strength; those of a secondary degree of vigour will furnish much better plants in a row by themselves than if they were mixed with those that are stronger. For standards, the stocks should be quartered out at least two years, in order that the young shoots which they produce may possess the requisite degree of vigour. They may either be grafted near the ground, at half or at the full intended height of the stem. In the case of such varieties as are of a weakly, spreading habit of growth, it is, unquestionably, better that the stock should be allowed to grow up to form the stem of the tree; but with regard to varieties that have a vigorous, upright growth, and are not disposed to canker, it is immaterial whether the stem consist of the stock or of the variety worked low and trained up. Before the sap rises in spring, the stocks should be cut back nearly to where the graft is to be placed. The scions ought likewise to be cut off before their vegetation is excited by mild weather; they may, nevertheless, be taken off and worked at any time before the leaves expand. In this case, it is advisable to pick out the buds which have pushed, as they would evaporate the sap and dry the scion before it could unite so as to derive nourishment from the stock. There are usually two small buds, one on each side of the principal one, and they generally remain dormant; but when the central bud is removed, the sap flowing towards it is shared by the lateral ones, and they consequently become developed so as to contribute to the formation of a union with the stock. Although grafting may be thus effected and advantageously practised in particular cases, yet it can only be considered as an exception to the general rule—that of cutting off the scions before the buds exhibit symptoms of pushing. The scions should be kept till the grafting season, in the same way as already directed for those of the apple.

Quince Stocks.—There are several varieties of the quince, some of which are much better adapted for stocks than others. The Portugal quince has the broadest leaves of any of the sorts usually employed for the above purpose, and its growth is the most vigorous; consequently, its stem enlarges more in accordance with that of the pear than in the case of

varieties with smaller leaves, and of more contracted growth. The Portugal quince is recommended by the French authors as a stock, unless extremely dwarf trees be the desideratum, and then the varieties of smaller growth are to be preferred, because they do not permit the sap to flow so freely, and have, therefore, a more dwarfing effect. In general, however, either the Portugal, or some of the broadest leaved and most free-growing varieties of the common quince are the most proper, for such will not be found to supply more than sufficient nourishment when the tree arrives at a fruiting state, which, by judicious management, may soon be the case. It has been said that the pear on the quince stock is but short-lived. It cannot of course be expected to live so long as when worked on the pear stock, a more natural condition; yet we can point out trees on quince stocks that have existed nearly forty years and are yet vigorous, exhibiting no symptoms of decay.

The quince is readily propagated for stocks by cutting down the plants when they are strong enough to throw vigorous shoots; and the bases of these are covered with earth, in order that they may strike root. This mode is adopted in the neighbourhood of Paris, but better plants will be produced by layering at any time during the winter months, and proceeding in the following manner:—"When the young shoots are laid down, there should not be more than two eyes left above ground, and when those have grown 5 or 6 inches long, one of them should be cut clean off, leaving the other to form the plant, which by the autumn will be 3 feet high.

"The layers must be taken off the stools as soon as the leaves are fallen, and planted out in rows at 3 feet apart from row to row, and 10 or 12 inches from plant to plant in the row. At the end of one or two years they will be fit to bud or graft with the different sorts of pear, for quenouille or for espalier training; or they may be allowed to grow up and form standards for orchard planting."—(*Lindley's Guide to the Orchard and Kitchen Garden*, p. 477.)

The quince pushes early in spring, if the weather is at all favourable. In mild springs we have seen it in leaf at the usual grafting season in March; and we have also seen the plants headed down at that period and grafted, but with very bad results. Either the grafts did not take at all, or but imperfectly, for the quince stock, having been cut when the sap

was flowing, died back to a considerable distance below the place where it was cut over, so that if the lower part of the scion did unite with the quince, the upper part of the splice could not. To the circumstance of not heading down quince stocks till their vegetation is too far advanced, is chiefly to be attributed the want of success in grafting them with the pear. The stocks should be headed down in January, almost to the place most eligible for grafting. It is then advisable to leave a little to be cut off at the time of grafting, because severe frost may ensue and occasion some small splits or cracks in the exposed section of the stock.

In using the quince as a stock, we want its root, and but very little of its stem—no more of it, indeed, than is sufficient to receive the graft. If the graft were placed, say 9 inches or 1 foot above the surface, the quince portion of the stem below that height would most probably not increase in thickness in the same ratio as the pear, and thus, instead of the stem being thickest near the ground, it would be abruptly smaller. The quince should therefore be worked close to the ground, so as to have no portion fully exposed to the drying influences of the sun and air.

Whip-grafting is the best to adopt. After the grafts are clayed, it is a good plan to earth them up as high as the top of the clay.

As the roots of the quince run close under the surface, and as it would not be advisable to disturb them by taking soil for earthing up from between the rows of stocks, it should be taken from the alleys, or elsewhere. When these particulars are attended to, the failures are very few. Of all things, the necessity of cutting down the stocks early in January should be particularly borne in mind. It may even be done in December. If deferred till the unfolding buds and leaves indicate a state of active vegetation in the top, the latter, on being cut off, carries with it nearly all the strength of the plant, so that the portion left must long remain weak, stunted, and unfit for nourishing the pear scion that is worked upon it.

The advantages offered by the quince as a stock for the pear are, as compared with the pear stock, a more dwarf growth of the tree, a more shallow disposition of the roots, earlier bearing, and sometimes the fruit is larger and better ripened. The dwarf habit induced by the quince stock renders it peculiarly eligible for trees that have to be planted in a

limited space, as pyramids or espaliers, and even against walls that are not of great height. Owing to the shallowness of the roots of the quince, they are better adapted for thin soils, also where the subsoil is unfavourable and occasions canker when the deeper roots of the pear enter it. Trees worked upon the quince may also be removed any autumn till they are at least twenty years old. We have known a number of such trees moved with ordinary care when nearly thirty years old, and without a single failure. The fruit is usually higher coloured than on the pear stock, and sometimes it is larger if the tree is in a vigorous state. This increase in size and colour is owing to the partial check which the sap receives when, in returning, it reaches the vessels of the quince, and has to be subjected to the organization of the latter. Any check to the returning sap, such as that from ringing or from ligatures, has a similar effect; only by employing these means the cause and effect are more apparent. In cold situations, and in damp soils into which the roots of the pear stock would penetrate and draw colder sap than would be congenial for nourishing the fruit, the quince stock may be advantageously substituted; for, if the soil were laid sloping to the sun, it would be raised by the solar rays, to the depth of at least 1 foot, to a much higher temperature than the subsoil would be. The quince roots can be kept at about 1 foot below the surface, and, consequently, in a medium so much warmer than that of the pear roots as to induce an earlier and more perfect ripening of the fruits.

The pear will also succeed for a time on the common hawthorn (*Crataegus Oxyacantha*), and from trees worked on this stock, fruit has been obtained as large as from those on the quince, and of equally good flavour. It may be conveniently used for working with scions of different sorts when neither quince nor pear stocks are at command. The hawthorn plant should be cut down early and, like the quince, as close to the ground as it conveniently can be worked. Probably some of the other species of *Crataegus* would answer as well as, if not better than, the common hawthorn.

On the mountain ash (*Pyrus aucuparia*), and the medlar (*Mespilus germanica*) the pear may also be grafted with tolerable success. It seems, however, not to like these so well as it does even the hawthorn, and therefore they need not be further noticed.

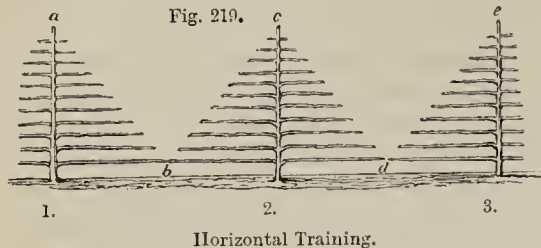
Soil and Situation.—The pear tree succeeds in any good, deep, loamy soil, provided the subsoil is well drained, so as to be free from stagnant moisture. But, as in the case of the apple, a soil that is too free is not suitable, especially in localities where the amount of rain is limited, or does not average more than 24 inches per annum. In fact, the remarks already made with regard to soil, situation, and moisture, in the article on the apple, are also applicable to the pear. Where the apple tree will grow well the pear will also thrive, only the roots of the pear stock will sooner find their way into the hard subsoil than those of the apple. The pear will thrive on a strong loam, but not on a stiff clay, at least not until it is well drained, trenched, and otherwise ameliorated.

It is essential that the trees should start vigorously, and therefore, if the soil is not naturally very rich, a compost in which to plant the tree should be formed. A mixture of good turfy loam and farm-yard manure will be very suitable. These should be placed in alternate layers, a year or at least six months before the time of planting. After having lain two or three months, the materials should be turned and well mixed, and if again turned some time before using so much the better. By employing more or less of this compost, according as the soil is more or less in want of enrichment, the trees will soon be in a condition to make vigorous growths; and, if these are properly managed, the trees may be reared to a size fit for bearing a heavy crop in half the time that is required when they are stunted for want of nourishment after having been transplanted.

Distance between the Trees.—Standards should not be less than 30 feet from row to row, and about 24 feet from each other in the row. Where more space can be spared, the next wider distance may be 36 feet between the rows, by 30 feet in the row. In either of these cases the ground between the trees can be equally divided into 6 feet spaces for rows of currants or gooseberries.

In planting against a wall, it is an important object to cover it as quickly as possible, consistent with allowing the trees sufficient room. It is evident that the wall will sooner be covered by close planting than by placing the trees widely apart. At wide distances, trees trained horizontally will reach the top of the wall as soon as others that are planted

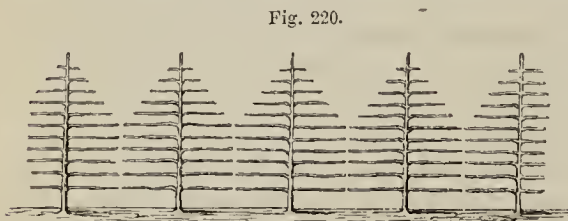
more closely together, but for many years there will be larger spaces uncovered between those that are widely planted, as will be readily understood on referring to Fig. 219. Supposing



Horizontal Training.

that the wall is 13 feet high, and that the upright is annually stopped so that one course of horizontals will be made in a year; then, in twelve years, the horizontals being 1 foot apart, the leader will reach the top of the wall. Presuming that, at the expiration of this period, the lower horizontals of the trees 1 and 2 meet, it is then evident that only half of the wall will be covered; for the space covered by the side of the tree No. 1, and that covered by the side of the tree No. 3, are together equal to the unoccupied space, *a b c*; whilst the space covered by the tree No. 2, is equal to the other unoccupied space, *c d e*. In short, it is easy to observe that the covered spaces form four triangles, and that the uncovered spaces form four similar triangles equal to the former, so that half the wall is covered, and half not.

Supposing the trees had been planted at half the distance apart, as in Fig. 220, also



Horizontal Training.

that they had grown at the same rate as in Fig. 219, and accordingly reached the top of the wall in twelve years, it will be observed that at the end of that period all the horizontals, from the base as far as half the height of the wall, will have met. The lower half of the wall is, therefore, entirely covered, and the covered and uncovered portions of the upper half being equal, there is only one-fourth of the surface uncovered, whilst in the case of trees planted at double the distance only one-half of the wall is covered. If we calculate the difference

in regard to time, we shall find, that by planting at half the distance, as much surface will be covered in three years as will be the case in four years by the other plan. Now, as walls are expensive, it is therefore desirable that they should be covered as soon as possible. Close planting, as above shown, will contribute to that object; and the question is, to what extent this may be carried as regards the pear. We know that, in time, pear-trees in good soil will profitably occupy a wall of ordinary height, if planted at 30 feet apart; but at such a wide distance, there must be a large space of naked wall for many years. The greatest distance that need be allowed between the trees is 24 feet; but less than this would be desirable when the object is to appropriate the space rapidly. When wall trees were badly managed, when by close planting the branches had to be much shortened to keep them within the prescribed limits, and when, in consequence of this shortening, a mass of shoots sprung up, one of two things usually happened. These shoots were either allowed to grow during summer and cut closely off in winter, entirely wasting so much of the strength of the tree, or they were cut down near to their bases, with the view of forming spurs at the portions left; but instead of spurs fresh shoots were usually produced. With such management, close planting was certainly not to be recommended, because it induced growths which, unmanaged, became an evil. But now it is different; for, by judicious summer pruning, trees can be kept in very small compass; thus, pyramidal-trained pear trees can be kept within a space not exceeding 4 or 5 feet in diameter. This being the case, it is not unreasonable to suppose that, by employing similar means, a horizontal-trained tree might have its branches limited to an extent of 10 feet. This we know to be possible; but to do it properly would require more strict attention than could, in many cases, be given. We would therefore recommend not less than 15 feet as the minimum distance which should be adopted, and 20 feet as the maximum. If the soil is very rich, we consider 20 feet a proper distance; and where but moderately so, 18 feet. It may indeed be said that 24 feet, with riders between, would be preferable; but riders are not much to be depended upon for fruit, though they answer the purpose of covering the wall; moreover, by the time they

are in a good bearing state, they have to be cut away to make room for the permanent trees. The distance to be allowed between these has therefore been considered irrespective of riders.

Pruning and Training.—The stems of standard pear trees should be reared according to the directions already given in treating of the apple. Three shoots are obtained at the proper height for constituting three main limbs, and each of these should be cut so that two shoots may push at from 9 inches to 1 foot from its base; thus, as in the case of the apple tree, six main branches will be produced, a number which will be quite sufficient. For several years all shoots that push from the principal branches should be kept subordinate until the latter have diverged so far as to afford an abundance of space for an intermediate branch. Where space allows of a greater number of branches being originated, they may be produced at any place by cutting back to suitable buds at that place. It has been explained that three buds will usually push immediately below the section; but, in the case of open standards and dwarfs, three branches, with the exception of the three main limbs, should never take their origin from the same point, or, at least, from three contiguous buds. There ought to be no tridents in the tops of trees so trained, and one of the three buds should either be cut closely off, or shortened and managed so as to form a spur. When subsidiary branches are encouraged from each of the six main limbs, it is desirable that they should proceed alternately from opposite sides, in order that each branch may be balanced; for, when this is the case, it will better resist the wind. If each of the six main branches be well balanced by having as many branches on one side as on the other, if the ramifications on both sides possess the same aggregate amount of vigour, and, further, if equality is maintained between the six principal branches themselves, the tree may be considered to be properly managed as regards the disposition of its branches.

Whilst encouraging six principal branches, by taking care to check vigorous shoots that otherwise would become competitors, nakedness should at the same time be guarded against. Some varieties are naturally disposed to branch, but others are apt to produce shoots that run naked nearly their whole length. These, then, require to be shortened,

in order that shoots to form branchlets and spurs may be produced. When the top of the tree becomes large, the spurs on the bases of the large limbs will be apt to die off, from their foliage not having so full a share of light as those on the outside. This can be prevented to some extent by keeping the branches on the south side thinner than elsewhere, in order to admit the sun's rays more freely into the interior. After the heads of standard trees have been kept regulated for several years as above directed, the tree will generally have to be left to follow its natural mode of growth. Yet all gross irregularities should be prevented: branches must not be allowed to cross each other, and shoots that are evidently taking a wrong direction, ought to be cut out before they become branches. When the tree arrives at a bearing state, branches loaded with fruit will be more or less weighed down, and when a branch is bent during any considerable portion of the growing season by fruit or any other weight, it retains nearly that form after the weight has been removed. Hence, in full-grown trees, the extremities of the branches are generally turned downwards, a direction unfavourable for the prolongation of shoots, but conducive to the formation of fruit spurs. In old standard trees, it will be observed that the fruit is chiefly produced at and near the extremities, and there of course it is best situated for light and air. Not unfrequently, however, when the tree is in this condition, vigorous, upright shoots push from strong branches in the interior of the head of the tree. These are injurious, for they appropriate the sap that would otherwise contribute to the nourishment of the fruit spurs at the extremities. The sap will rush into these vigorous shoots as it would into suckers, and it is well known that the more vigorous they become, the weaker are those situated in the older parts. All upright shoots in the centre of the tree should therefore be entirely cut off, or treated so as to form a spur.

Instead of forming a head from six equally diverging branches, some prefer the pyramidal form, which certain varieties naturally assume. The upright shoot of the young stem should, in that case, be stopped at the proper height; but the shoots which result ought not to be made to diverge equally, but one should be trained as upright as possible; and, subsequently, a central perpendicular shoot ought to be encouraged, so that the head of the tree

may consist of a central stem with branches proceeding from it. These branches should be kept on an equality, so that the top may be equally balanced; and any branch or shoot that pushes much beyond the others must be checked.

Pyramid-training.—Where it is desired to grow a number of trees in a small space, the pyramid form, Fig. 221, is the best. It is well adapted for small gardens, in which, if a single standard tree were planted, the whole space would perhaps be over-shaded; but with dwarf pyramids the owner could have many trees ripening their fruit in succession. As regards the form, the main object to be kept in view is a perpendicular stem with every branch proceeding from it shorter in a horizontal direction than the one below it.

In proceeding to details, it will be best to commence with a maiden plant which we shall suppose to be planted, in November, either in the nursery or where it is to remain. The plant should be topped a little, but not cut so far back as to make the buds break near the ground. Next autumn, let the plant be cut back near to the place where it was budded or grafted. If the tree has been well planted, and has made a fair quantity of leaves, and consequently roots, it will push from its base, in the course of the summer, a strong shoot, which should be trained as upright as possible. In November, cut it back to 13 inches from the ground, and below this cut, several shoots will push: the upright must be trained in a perpendicular direction for a continuation of the central stem, whilst the others will form the lower tier of branches. These should be allowed to grow without restraint till Sep-

Fig. 221.



Pyramid Training.

tember, and then they ought to be all bent to nearly a horizontal position. But some may be weak and others strong: the latter must be most depressed, whilst the former should be allowed to retain their natural position till they acquire sufficient strength to be bent down in the following summer; but if likely to interfere with the young shoots above them, they must be trained so as to keep clear of these.

In the end of November, any laterals that may have been produced on the branches of the lower tier, should be cut to within 1 inch of their bases. At the same time the upright leader must be cut 15 inches higher than in the preceding season, if the soil is very rich and the climate moist; otherwise, only 1 foot higher, more especially if the variety is not a strong-growing one. This will cause shoots to push for another tier of branches. By these means the two lower tiers will have been obtained, and in the same manner as many more as may be desirable can be produced.

In cutting, in autumn, above a bud for a leader, the cut should not be made too close to the bud, otherwise the latter is liable to be more or less injured if the frosts should prove severe. It will therefore be advisable to cut at least $\frac{1}{4}$ inch above the bud; but, when the latter has just pushed into leaf, the portion left above it should be cut close off, in order that the shoot may grow upright.

Instead of obtaining only one stage of horizontals annually, two may very well be produced after the first two, if the trees are growing well. It is advisable to originate the two lower stages from buds on the mature shoot as above directed, for it is important that they should be well established; but afterwards the upright leading shoot may have its growing point pinched off in summer when it has pushed to the height of 12 inches. This will occasion the production of several shoots at or near that height, one of which should be trained to grow upright during the remainder of the season, and afterwards be cut over at 12 inches above where it was pinched, that is, at 2 feet from where it pushed in spring.

Having pointed out the manner, in which the stem is reared, and the mode of originating the side branches, we shall now turn to the management of the latter. They should be pruned and trained with an aim to give the tree the form of a pyramid or cone, of

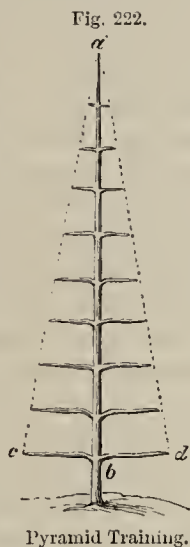
which, if the tree is intended to be of limited extent, Fig. 222 may represent a section. Its total height is about equal to its circumference at the widest part, a proportion which, according to the French authors, is considered to give the most elegant appearance.

If the distance from the base *b*, to the apex *a*, be 10 feet, the circumference at the widest being as much, the diameter at *d* will be about 38 inches. The branches must therefore be kept within the limits *a c* and *a d*. The upper branches will be strongly disposed to extend, not only beyond the limits represented by the dotted lines, but also much beyond the horizontal extension of the lower branches.

This must, however, be prevented by an early stopping of the shoots. In summer, as well as at the winter pruning, the regular slanting outline of the tree must be kept in view and strictly maintained, otherwise the vegetation of the top will soon be in a condition to draw the greatest share of the sap. This, permitted to flow in large proportion to any particular part, as for instance to the top of the tree, is unfavourable to fruitfulness. We must therefore endeavour to distribute the sap as equally as possible. If all the branches were of equal length, the tree would be like a cylinder, but they would be equal as regards their length and that only, for their vigour would be very different, vegetation being much more active in the upper than in the lower part. When subjected to the pyramidal form, the upper branches are shortened so that the quantity of foliage they bear is less than the lower ones do, and thus the flow of sap will be limited in the part where, otherwise, it would tend to flow in excess.

The above remarks will be sufficient to show the necessity of strictly preserving the outline, but all within will be a mass of shoots unless attention is paid to pinching and summer pruning, for on these the success of trees trained as pyramids chiefly depends.

Summer Pruning and Pinching the Shoots.—It is evident, that if the shoots of a pyramidally-trained tree were not shortened and thinned, their foliage would suffer from being



shaded and crowded. It is also certain, that if the laterals were allowed to grow till the winter pruning, they would either have to be cut off entirely, or, if then shortened, a number of shoots would push from their bases and cause greater crowding in the following season than before. Such being the consequence of cutting back shoots at the winter pruning, in order that little winter pruning may be necessary, recourse must be had to summer pruning, an important operation, respecting which, however, there is much diversity of opinion. We shall consider it in detail, both as regards the parts to be operated on, and the time and manner of performing the operation.

A pyramid-trained tree consists, essentially, of an upright stem, and as many side branches as can be properly trained without overcrowding. There must be space between them for fruit spurs when these come to be formed. All shoots not required to form the stem or the branches from it must be summer pruned, either by the knife, or by pinching between the finger and thumb. The operation should be performed on laterals that push from the young summer shoots that are intended to form a permanent part of the tree, as well as on those of the older wood. The time varies with the earliness or lateness of the season; and again, as a general rule, the operation should be performed sooner upon the upper and more vigorous parts of the tree, than upon the lower and less vigorous portions.

M. L. Cappe, of the Jardin des Plantes at Paris, pinches the shoots nearest the leader, when they have pushed to the length of from $2\frac{1}{2}$ to 4 inches, so as to leave them only 1 or $1\frac{1}{2}$ inch in length. Those situated lower, he allows to grow to 6 or 8 inches long before he pinches them.

M. du Breuil recommends the laterals to be pinched back to little more than 1 inch, when they have attained the length of about $2\frac{1}{2}$ inches. According to M. de Jonghe, of Brussels (*Gardeners' Chronicle*, 1854, p. 629), the laterals of trees worked on the pear stock should be stopped or pinched when they have developed six or seven leaves; and those on the quince, when they have made five or six leaves.

It is now found to be the best mode, to allow the lateral shoots to push *six leaves*, and then to pinch them *immediately under the sixth leaf*. There are usually latent, or only partially developed buds at the base of the

shoot, with occasionally some small imperfect leaves, but in counting the six leaves these should be omitted. The more vigorous shoots will generally be those that will first attain the above extent of growth, and accordingly they will be, as they ought, the first that are stopped or pinched. Many of the shoots will push again after the first stopping, and when these are 3 or 4 inches long they are pinched back to three buds, or to about $1\frac{1}{2}$ inch from their bases.

With regard to the terminal shoots of the branches, those that extend in summer beyond such as are situated below them should be pinched, but the others ought to be allowed to grow till the beginning of September, when they may be cut to their assigned limits, so that any further shortening at the winter pruning will be unnecessary.

From what has been already stated, any one may rear and maintain handsome and productive pyramid pear trees; nevertheless, the nature of the proceedings having been explained, the chief points may now be briefly recapitulated, to render them of still more easy comprehension. The tree, having been trained with an upright shoot, is cut back before winter in order that it may produce side branches near the ground; and a shoot is again trained upright and cut so as to produce more laterals and a shoot for the continuation of the stem; this shoot may be stopped, if vigorous enough, when it has grown about 1 foot. This will tend to throw more sap into the side branches below, whilst the upright leader, from its advantageous position, will soon regain sufficient strength. Laterals from it must be pinched when they have grown 6 or 8 inches; by shortening them at the winter pruning to within 2 inches of the stem, they will produce shoots strong enough for side branches, and, at the same time, the pyramidal form of the tree will be preserved. By stopping the leader in summer, side branches will result, so that at the winter pruning it will only be necessary to cut it 2 feet, instead of 1 foot, above where it was cut a year before. Thus, without danger of a deficiency of side branches, an advance of 2 feet in height is gained in one season. In subsequent years, the upright shoot may be treated in a similar manner till the desired height is attained. It is necessary, however, to observe that where the climate is such as not to ripen the wood of the summer shoot properly, it is better to allow the leader to go

on without stopping, and originate the side branches by cutting back to 12 inches in autumn. The laterals from the side branches may be made to form fruit spurs instead of overcrowding the tree; they must be pinched under the sixth leaf when they have developed that number. The terminal shoots should be allowed to grow till the end of August, when they ought to be shortened to within eight buds or leaves of the stem, not taking into account the buds at the base of the shoot which usually do not push. At the winter pruning, the ends of the branches must be pruned so as not to exceed the symmetrical outline of the tree.

The above directions are applicable to pyramids strictly kept, and of the smallest dimensions; and any one that can rear such can easily manage those of larger size. In some cases, pear trees are allowed to form pyramids as much as 15 feet high, the side branches extending in proportion; but for these it is only necessary to allow greater extension to the terminal shoots of the branches, and to the upright stem; in all other respects the directions already given should be followed.

At the Jardin des Plantes at Paris, we saw trees trained in the following manner:—The stem of a tree about 15 feet high is kept upright by a long straight pole, from the top of which five wires are stretched and secured, at equal distances, to a hoop near the ground or to five stakes, the wire thus representing the angles of a five-sided pyramid. Towards each of the wires branches are trained from the stem, the spaces between these being kept clear. The trees so trained produce a very good effect, and the plan might be advantageously adopted where large pyramids can be grown.

Espalier Training.—Of all modes of training the pear tree in the open ground, the espalier, if well conducted, is unquestionably the best; it is the most economical as regards space, for if the espalier is only 6 feet high, there may be six horizontal branches on each side, and each branch extending, say 10 feet, the aggregate length of the branches will then be 120 feet. The ground may be cropped to within 1 foot of each side of the espalier: each tree trained upon it, and extending 20 feet, occupies, therefore, only 40 square feet. The same extent of branches trained as an open dwarf, would occupy a space of 10 feet square or an area of 100 feet.

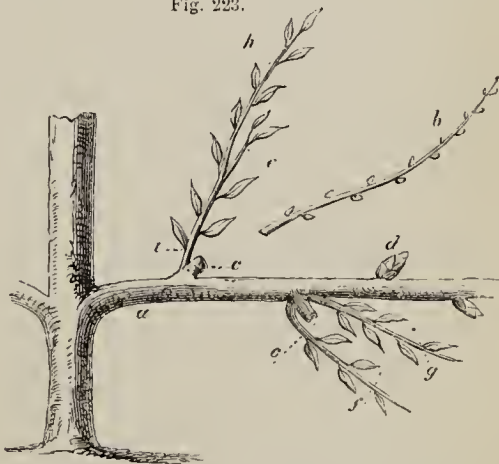
The mode of rearing a central stem, and that of obtaining branches from it where required, have already been explained; and, once the horizontals are started, no one can be in any doubt in training them, as far as the correct form of the tree is concerned—all he has to attend to is simply to train them right along; whilst in the fan and other modes of training, many considerations are sometimes necessary with respect to the position and direction of the branches. The espalier mode gives good command over the growth of the tree and the equal distribution of the sap; at the same time, the branches are all equally exposed to light. Equality of vegetation is conducive not only to the health of the tree, but also to its productiveness; and, accordingly, well managed espalier trees are very productive, and generally bear larger and better-formed fruit than can be obtained from standards. On the latter, it is true, many of the newer large kinds of pears succeed, yet, from their weight, they are apt to be blown down and spoiled when almost fit for gathering, whilst on espaliers all fruits are nearly secure from this danger. The quality of fruit grown in this way is often superior to that produced on east and west walls. The advantages of this mode of training the pear are many, whilst the only drawback is the expense of the espalier rail. This, however, will be amply compensated by the superiority of the produce which can be obtained from well-managed trees trained against espaliers, even constructed of very cheap materials. In all first-rate gardens, and indeed wherever they can be afforded, rails of a substantial construction should, however, be erected.

The distance between the pear trees intended to be trained against espaliers should be about 20 feet; and the espaliers, if there be two or more parallel rows, should be 15 feet apart. When placed along the sides of walks, the line of rail ought to be $2\frac{1}{2}$ feet from the edge of the walk, and the trees should be planted 3 inches from the rail, otherwise the latter would be pressed out by the stem when it becomes thick. The trees should be planted on the side of the espalier next the walk. There may be some objection to this as regards the trees on the south side of a walk running east and west; it would, it is true, be advisable to plant them on the south side of the rail, but a much better effect is produced when they face the walk on both sides.

The branches of a horizontally-trained pear tree against an espalier should be about 1 foot apart. The mode of heading down the upright stem to obtain these is the same as in the case of the apple. The lower ones should be started a little below the line along which they are intended to be trained; the upper courses ought to proceed very nearly at right angles from the stem, and the highest one quite so.

In order that the young tree may speedily acquire strength, the shoots should not be much pinched, or otherwise shortened, in the early part of the summer at least. Those near the extremities of the horizontals ought, however, to be checked so as not to compete with the terminal shoots or leaders of these branches. In order to throw more strength into the branches, the upright leader should be pinched when it presents the appearance of becoming too strong. By these means the sap will be diverted into the bases of the branches, natural fruit spurs will soon begin to form upon them, and in four years from the time of planting, the tree will most probably commence bearing. In order to have well-formed fruit, the fruit spurs should not be nearer each other than 6 inches; therefore, at the winter pruning, shoots that have pushed along the branches closer to each other than that distance, should be cut off quite close. All others should be shortened back to within 1 inch of their base. Fig. 223 represents a

Fig. 223.



Pruning Horizontally Trained Pear Trees.

portion of the horizontal branch of a pear tree. In the course of the season it will either produce shoots, as at *b*, or natural fruit spurs, as *d*. At the autumn or winter pruning the shoot *b*, and others similar to it, should

be cut back to about 1 inch from their base, as at *c c*. In the following spring a shoot *e*, will push below *c*, from the part left of the shoot *b*, or two may push, as *f g*. If more than two push, all but that number should be rubbed off, or cut very close so as not to be apt to push again. When the single shoot, *e*, has made six leaves it should be pinched or cut closely under the sixth leaf, as represented at *e*. With regard to the shoots *f* and *g*, one of them should be cut like the shoot *e*, under the sixth leaf, as at *g*, when so many have been formed, the other under the fifth leaf, as at *f*. This is done with the view of giving more strength to one of the two, in order that it may take the lead as regards the flow of sap; for, if this be attracted more especially to a leading point in one season, it will tend to flow towards the same part in the one following; and one shoot of a fruit-spur is much more easily managed than when numerous small twiggy shoots, too weak for forming fruit buds, are pushed. This does not affect the principle on which an equal distribution of the sap is recommended, for by that is to be understood an equal distribution into parts that will be useful, and not into a multiplicity of shoots, weak, in proportion to their number, in consequence of the limited supply of sap to each, as well as of the privation of light occasioned by their crowding each other. In all probability the shoots which were shortened, as at *e f g*, will push shoots from the buds in the axil of the leaf below the respective sections, as at *e*. When this second shoot has pushed several inches, it may be pinched or cut off below the fourth leaf, as at *h*, and likewise those that proceed from below *f h*, and others similar. At the autumn pruning, the shoot *h* should be cut back to within 1 inch of its origin. Buds for spurs may have commenced to push during the summer from the base of the preceding summer's shoot below *c*; if not, one or two will likely appear in the following summer. At the same time, a bud or buds of this description may also form on the base of the younger shoot, at a point below *i*, but more likely a shoot will push if the tree is young and vigorous, and if so, it must be managed like its predecessor.

If any branch is weaker than the rest, the summer shoots upon it, or at least a considerable portion of them, should be allowed to grow without stopping till September, when a few inches may be cut off from the extremity of

each. If the whole tree is weak, the shoots on all the branches should be treated in a similar manner. In that case, the summer shoots ought to be cut back in winter to about 1 inch from their base. From the stubs left, shoots will generally proceed in the following season; part of them may be pinched, as in Fig. 223, at regular distances along the stem, others may be allowed to grow till September, when they may be stopped and cut back to about 1 inch from their base as before. There will then be about 1 inch long of the base of the first year's shoot, now two years old, and as much of the second year's shoot, which is only one year old; from this a shoot may be allowed to grow till September, when it should be stopped; but instead of cutting it back to 1 inch, it should be cut off entirely, together with the former year's wood on which it took its rise. By so doing, there will be left a stub consisting of about 1 inch of wood, now three years old, terminating in a portion only two years old. On such portions fruit-spurs will generally form.

Espaliers will generally bear very well, if not so closely pruned as above indicated, provided means are taken to insure an equal distribution of the sap in all the branches. If this is neglected, no system of management will insure fruit in that perfection which would be the case if the above principle were duly carried out. The means of doing so have been already fully explained in treating on pruning, therefore they need not be here repeated. Whether the trees are worked upon the pear stock or upon the quince, they will generally soon become fruitful, and continue healthy and productive for a long period, if over-luxuriance in one portion be prevented by timely checking, whilst more than an average liberty is allowed the weaker portions till the balance is re-established.

Pruning and Training Trees against Walls.

—The modes of training usually adopted are the *horizontal* and the *fan*. The former is to be preferred for walls of ordinary height; but in the case of trees planted against the ends of houses and other walls which are much higher than those of gardens usually are, fan-training is the more advantageous, for by it the upper part of the wall can be much sooner covered. Ample instructions for obtaining the requisite number of branches at the proper distances from each other have been already given in the chapters on pruning and training,

as regards both horizontal and fan-trained trees. The branches of a pear tree intended to be trained horizontally against a wall should be the distance of four courses of bricks apart. At this distance, the tree will sooner reach the top of the wall than if the branches were trained at three courses or 9 inches apart; but it may be said that, although the wall is sooner covered, it will not be covered thickly and efficiently. There will be a greater extent of naked wall between the branches; but this is a great advantage, especially in the colder parts of the country; for, where a wall is almost completely shaded with foliage, it receives but little heat from the sun's rays, and, consequently, but little can be radiated for the benefit of the tree. For this important reason, a distance of 12 inches between the branches is recommended; and more especially as it is well known that branches, even at that distance, if well managed, will bear as much fruit as a tree can bring to perfection.

The first pair of horizontals should be at least 1 foot from the ground; but 15 inches we consider preferable, because the fruit will be better flavoured than when nearer the ground. The lower horizontals should be trained at an angle of about 45° , in order to strengthen them, for they cannot be too strong; and, in fact, every means should be taken to encourage them to make vigorous growth. With this view, lateral shoots, if any are produced, ought to be allowed to grow freely during the summer, and their points should be taken off in September. Before winter, the upright leaders ought to be cut, so as to originate a second pair of horizontals, and, at the same time, the laterals on the first pair should be cut to within $\frac{1}{2}$ or $\frac{3}{4}$ inch of their base. In the second season, the shoots on the horizontals should still be allowed to grow without check, except in the case of any likely to be too strong for the leaders of the horizontals, and, wherever this is seen to be the case, they must be pinched. The others may also be pinched, if they grow so long that they begin to droop and shade the buds on the horizontal branches.

When several courses of horizontals have been obtained, the highest should be subjected to a closer system of summer pruning. They ought, for the most part, to be pinched as directed for espaliers; after an interval of five or six days the next lower tier should be pinched, and so on to the lowest. When more hori-

zontals are formed, six courses for example, the two upper may be pinched first; after several days the next lower two, and after another similar interval the lowest two. In short, by commencing summer pruning at the upper part of the tree, and working gradually downwards, at intervals, so as not to deprive the tree of too many shoots or too much foliage at one time, the trees will form abundance of fruit-spurs, and bear regularly from the stem to the extremities of the branches. The spurs will, most likely, be too numerous, and will require to be thinned and shortened at the winter pruning.

Pruning the Spurs.—A spur is a sort of branch, the buds of which are either blossom buds, which do not push into regular shoots, or imperfectly-formed blossom buds, in which case they elongate, although but slowly as compared with the growths made by the proper shoots.

Spurs are either simple, as represented at 1, Fig. 224, or compound, as at 2. They require to be pruned, otherwise they

would extend too far from the wall, and would lose the benefit of its warmth. It is therefore desirable to have a sufficient number of fruit-spurs as near the branch as possible, and, when that is



obtained, the spurs should be more or less cut back at the winter pruning. The simple spur, 1, requires no pruning. Such an one is likely to bear fruit, and in that case its terminal growth will be arrested, and one or two fruit buds will most probably form near its base. The spur, 2, is an older production. It may be cut off at *a*, or, if there are plenty of others near, it may be cut back a little above the bud, *b*, which will form a fresh spur. All buds similar to *b* are blossom buds; but spur buds, like *c*, may retain their slender form for years, without assuming that plumpness which indicates a fruiting state. It is frequently the case that nearly all the spur buds on a tree are of this description, and are very numerous, abundance of foliage being produced, and every year more and more of these slender, unfruitful spurs. The best way of dealing

with them is to cut back those on the upper part of the tree to the lowest bud or the lowest two buds, to thin and shorten considerably those situated about the middle of the tree, and to do this more sparingly in the case of those on the lower part. By these means, the lower branches, which are usually weak as compared with the upper, will become equal in vigour to the latter; the sap will flow equally to all parts of the tree; and weak, elongated, barren spurs, will become plump and fruitful. The spurs on the middle and lower parts of the tree will require to be gradually reduced; and, whilst this reduction is being effected, care must be taken that the upper part of the tree do not acquire a superiority in point of vigour.

Thinning the Fruit.—Notwithstanding the thinning of fruit-spurs at the autumn or winter pruning, it is often the case, in favourable seasons, that much more fruit sets on a tree than it is able to mature; or if, favoured by a good season, it does bring a very heavy crop to tolerable perfection, it then generally rests from bearing for a season, thus producing in one year a surplus which is not much valued, and which can never compensate for the subsequent deficiency of supply. A full supply in every season should be aimed at, and every means tending to insure it ought to be adopted. The principal of these is thinning. This operation should be performed when the fruit is very young, and when injury from frost is not likely to occur. In a good season, when none of the blossoms are injured by frost, one or two fruits of a corymb take the lead, and the rest drop. Still, on a wall tree, where corymbs are very numerous, too many will remain. A number of the corymbs should therefore be cut or pinched off entirely, but without injuring the foliage on the spur below. The latter, having not so much as a single fruit to support, will generally perfect fruit spurs for the following season.

The largest, best formed, and finest flavoured pears are produced from the strongest buds and blossoms. They are generally the most forward, and are, consequently, apt to suffer most from late frosts, so that they can no longer maintain their pre-eminence in the same corymb; they cannot monopolize the flow of sap, and the extra portion of this, which they otherwise would have appropriated, is shared amongst the whole of the fruits, which are thus enabled to exist, instead of being, for

the most part, starved off. But what is the consequence? Instead of one or two perfect fruits from a certain amount of nourishment, the same amount is divided amongst a number of fruits, each having an equal, but all an imperfect supply. In this case, the cluster or bunch must be well thinned; but, even when that is done, those that are left will rarely be so good as when the boldest flowers, being uninjured, naturally take the lead.

After a tree has been loaded with a numerous progeny from weak blossoms, it is apt to prove unfruitful in the following season. In order to guard against this as much as possible, it is not sufficient to thin very much the young fruit of each corymb—a number of the corymbs must also be entirely removed. If abundant, every other one may be wholly dispensed with, and on those that are left the fruit may be thinned to one or two.

Gathering and Storing.—As a general rule, pears are fit to gather when, on lifting up the fruit to a horizontal position, the stalk, without pulling, readily separates at its junction with the spur. When the stalk requires to be pulled and twisted, and will rather break than separate from where it joins the spur, the fruit, in that case, has not acquired all the nourishment which it otherwise would derive from the tree. There are, however, exceptions to this very general rule. Some varieties that are apt to become mealy or too dry, are better when gathered before they will part by merely lifting up. Again, some kinds that are too musky, if allowed to hang till they part very easily from the tree, should be gathered before they are in that state; thus, Williams's Bon Chrétien is an excellent juicy pear when gathered early enough, but is disagreeably musky if allowed to hang too long. The Flemish Beauty must be gathered before it has even attained its full size; if it be allowed to hang till it become of a fine red next the sun, and thus acquire all the beauty of which it is susceptible, it is much deteriorated in quality; and, instead of being melting, it becomes dry and musky. Some very early pears must be gathered at a particular time; if removed from the tree a little too soon, they are watery and insipid; if a little too late, their flesh becomes mealy, or their flavour proves flat. Other early kinds ripen in succession, and must be gathered accordingly. Late varieties generally require to remain on the tree as long as they can safely be allowed to hang.

The most choice sorts of pears on walls and espaliers should be gathered by taking hold of the stalk, without touching the fruit itself, and without displacing the bloom upon its surface; for this serves as a protection from moisture. The fruit should be placed singly on shelves; late sorts may be placed in a single layer in drawers or shallow boxes, for in such they will have a more equal temperature than on the open shelves in the room; and a steady cool temperature is an essential condition in keeping fruit. Pears keep very well in pure, dry, silver sand, also when packed in kiln-dried straw, or in dried fern. Besides being employed for keeping fruit late, the two last-mentioned substances are well adapted for forwarding it, and, we may add, even for ripening it. If the fruit of a variety which usually ripens in the end of December is in abundance, and if a scarcity should occur in the end of November, the later ripening sort can be brought in condition to supply the deficiency by packing it closely in dry fern, in a basket, and placing it in a warm situation. The basket may be placed near a fire, but not too near, and the fruit will soon be fit for use. Many varieties that will bear well in rather cold parts of the country, in which, however, the fruit will not naturally become melting, may be greatly improved by packing them as above and keeping them warm. The proper temperature will vary according to the variety and the greater or less degree of maturity which the fruit has acquired. Some of the pears should be kept in a very slight heat, others of the same variety in a higher temperature, and by this means the most suitable degree of heat may be ascertained. By the above mode of proceeding, the quality of the fruit will be greatly improved, much more, indeed, than any one who has not tried the process could believe possible.

Diseases.—The principal disease to which the pear tree is subject in this country is *canker*. In America, the *pear tree blight*, or *fire blight*, is very common and destructive.

Canker, as in the case of the apple, attacks some varieties more than others; indeed, in both the apple and pear, this disease manifests itself in a manner so nearly alike that what has been said of it in regard to the one fruit, is also applicable to the other. Extremes of moisture and dryness at the root are to be guarded against. Where canker makes its appearance, the soil should not be made too

rich, for over-luxuriance of growth seems to encourage the disease, at least in our variable and ungenial seasons. It frequently happens, that for several weeks, with a warm south-west wind, vegetation is much excited in the early part of the season, and afterwards all at once checked for almost as long a period. This sudden stagnation must derange the flow and affect the quality of the sap, and a tendency to canker is the consequence. There are various kinds of pears, such as the Jargonelle and Brown Beurré, which, in many localities, are apt to canker in the open ground, but continue healthy against a wall, all other circumstances being the same. This shows that climate has much influence in the matter. The growth of shoots should be encouraged as much as possible in the early part of the summer, in order that the wood may be matured before frost sets in. When the trees commence to push, and shoots are being rapidly made, care should be taken that their vegetation receive no check for want of moisture; for, if it is then stopped, the trees are more disposed to grow late in autumn, which is not desirable. Too much moisture is very injurious, especially when it amounts to saturation and its coldness is equal to that of spring water; still, in wet seasons, and in certain circumstances, an excess of moisture cannot be avoided; but it becomes far more injurious when the soil about the roots has been previously allowed to become too dry. A pear tree that may have, at one time, too little moisture is badly compensated by having, at another time, too much. Roots that are rendered inactive from being in dry soil cannot be supposed to act so well when abundance of moisture reaches them, as others that have never suffered from dryness. If we wished to induce canker in a tree, we should select one that had grown vigorously during some rather moist season, and in the first dry, hot year, when the roots had absorbed all moisture within their reach, and could only afford a very inadequate supply to the leaves to make up for evaporation, we should afford it no assistance. Meanwhile, the leaves, deprived of their regular supply from the roots, will drain the tree of much of its proper juices; growth will be arrested or greatly checked, perhaps till autumn; and then a late growth will ensue. But vegetation cannot be healthy when the sap is transmitted through roots, stem, and branches, which have previously been half-dried, and

through tissues suddenly overcharged with water at a period of the season when little or no evaporation takes place, and when both heat and light are greatly diminished in power. It is well known that shoots made under these circumstances are soft and watery, never becoming matured, consequently they are extremely liable to be affected by severe frost. Only an imperfect layer of alburnum is produced, and portions of the cambium sometimes die, even on the stem, a circumstance which is indicated by patches of bark which form depressions where the substance has been dried up, owing to sap not having been supplied by the inner bark. All these derangements from unseasonable and imperfect growth tend to produce canker, and, as they recur more or less frequently, so will the tree be affected in a greater or less degree.

The best means of preventing canker are those by which growth is encouraged in the most favourable period of the season, that is, during the early part of summer, when there is light and heat to elaborate the sap, and time to mature the wood before these agents become weak in their action.

Although it has been recommended to encourage growth as soon as the weather is favourable, yet, where there appears to be a disposition to canker, a rapid and over-vigorous vegetation should be guarded against. The use of rank manures must be particularly avoided; whilst, on the contrary, the application of fresh soil will prove advantageous. By attending well to the condition of the roots, the tree may very probably be maintained in a healthy state; but, if in spite of every precaution, canker should appear, we may conclude that the disease, in this case, arises from the vicissitudes of temperature. To this also we believe the *frozen sap blight* of the Americans may be justly ascribed. According to Downing, the circumstances under which this disease is apt to occur are—a very sudden and early winter succeeding a damp and warm autumn. The trees are forced into a vigorous second growth which continues late; and, whilst the sap vessels are still filled with their fluids, a sharp frost all at once takes place, and is followed in the day by bright sun. By suddenly freezing and thawing, the descending current of sap loses its vitality and becomes dark and discoloured. "In the ensuing spring, the upward current of sap rises through its ordinary channel—the outer wood or albur-

num—the leaves expand, and, for some time, nearly all the upward current being taken up to form leaves and new shoots, the tree appears flourishing. Toward the beginning of summer, however, the leaves commence sending the downward current of sap to increase the woody matter of the stem. This current, it will be remembered, has to pass downward through the inner bark or liber, along which still remain portions of the poisoned sap, arrested in its course the previous autumn. This poison is diluted, and taken up by the new downward current, distributed toward the pith, and along the new layers of alburnum, thus tainting all the neighbouring parts. Should any of the adjacent sap vessels have been ruptured by frost, so that the poison thus becomes mixed with the still ascending current of sap, the branch above it immediately turns black and dies, precisely as if poison were introduced under the bark. And very frequently it is accompanied with precisely the odour of decaying frost-bitten vegetation."

Mr. Downing also observes, that, if the poison becomes largely diffused, the tree will sometimes die in a day or two; but that, if it is only slightly present, the tree will often entirely recover.

As this disease is owing to vicissitudes of climate over which, as regards a pear plantation, we can have little control, care should be taken to use preventive means. They are chiefly those which have been already pointed out for promoting the ripening of the wood. Extremes of moisture and of dryness in the soil should be avoided, as should, likewise, manure applied so as to stimulate the tree to late growth. Downing states that many persons have remarked, that pear trees growing in common meadow land were free from blight in seasons when those in rich garden soils were continually suffering from it. Severe pruning should be avoided as much as possible in this as, indeed, in all cases. It can only be necessary in certain cases, but not, in general, where the trees have been pruned and managed with due skill and foresight. Although the disease manifests itself but slightly in this country, in comparison with America, where the alternation from cold to an intensely hot sun is much greater, yet there can be no question that trees are injured when the sap, in full flow about the time the buds are bursting, is heated by the sun's rays and suddenly cooled

by frost at night. In parts of the country where the climate is such as to render protection necessary for pears against walls, such protection would be very beneficially employed, not only against frost at night, but also during a portion of the day when the sun's rays are very hot.

Insects.—Various insects which attack the apple also prove injurious to the pear. Amongst these are—the caterpillars of the goat-moth (*Cossus ligniperda*), the wood leopard-moth (*Zeuzera Esculi*), the figure-of-8 moth (*Episema cæruleocephala*), the pale brindled beauty-moth (*Amphidasis pilosaria*), the apple-blossom weevil (*Anthonomus pomorum*), and of the codling moth (*Carpocapsa pomonana*), as well as the garden chafer (*Anisoplia horticola*), and red-footed beetle (*Lupeus rufipes*).

The pear-tree oyster scale (*Aspidiotus ostreiformis*), so called from its resemblance to an oyster shell, is a very minute insect, sometimes formed on the bark, to which it is very similar in colour. Using a hard scrubbing brush, with soap and water and a little sand, is the most effectual remedy.

The red-bud caterpillar (*Pyralis luscana*) sometimes does considerable injury to the crop by preying upon the buds. The parent moth deposits its eggs upon the buds in June, and, in the following spring when the sap begins to flow, the caterpillar appears, and having penetrated into the bud, feeds upon it for four or five weeks, when, having attained its full size, it spins a white cocoon and changes into a chrysalis. Dusting the trees with newly slaked lime when the caterpillar makes its appearance, seems to be the only remedy.

The pear-tree chermes (*Psylla pyri*) both in the larva and perfect state, attacks the pear, and by exhausting the shoots of their sap, causes them to wither, the crop, as well as the health of the tree, being sometimes seriously injured in consequence. In addition to this, ants and wasps, which are attracted by the saccharine excrement of the larvæ, frequently remain on the tree and damage the ripe fruit. The best remedy consists in brushing down the larvæ with a stiff brush, and catching them on a cloth, where they may be destroyed. Afterwards, the tree should be washed at short intervals with a powerful garden engine. Syringing with a strong infusion of tobacco may also be attended with beneficial results.

The slug-worm, the larva of *Selandria atra* of Stephens (*Tenthredo cerasi*, and *Tenthredo æthiops*, erroneously, of some), a small, black, slimy caterpillar, occasionally does considerable mischief, in August, September, and the early part of October, by consuming the parenchyma of the leaves. The most effectual remedy is dusting the trees with quicklime, and repeating the application once or twice at short intervals. Syringing in the evening or morning, with a decoction of tobacco, $\frac{1}{4}$ lb. being allowed to 2 gallons of water, or with lime water, formed by mixing 1 peck of lime and 2 lbs. of soft soap with 30 gallons of water, have likewise been attended with very satisfactory results.

The pear-tree blister moth (*Tinea Clerckella*), a minute moth which appears in May or June, deposits its eggs upon the foliage, and the larvæ, immediately they are hatched, penetrate beneath the cuticle, and by feeding upon the parenchyma, cause numerous brown blisters. When full grown, which is the case in September, the maggot lets itself down to the ground, where it spins itself a cocoon on a leaf, changes into a chrysalis, and remains as such till the following season. When this insect abounds, all dead leaves should be removed in autumn and burned or otherwise disposed of, so that the chrysalis may be destroyed; the ground near the trees should be dug, and the trees themselves washed with soap-suds when the moths have laid their eggs.

The larva of the long-horned tortrix (*Tortrix quercana*, Fab.), a small greenish white caterpillar, forms a web on the under side of the leaves, by stretching a number of delicate threads parallel to each other, and beneath this covering feeds upon the parenchyma, leaving only the upper surface untouched. At a later stage of its existence, it acquires sufficient strength to roll up the leaves, becoming at the same time more voracious, and when full grown, it spins a white cocoon on the foliage, and changes into a reddish brown pupa from which the moth emerges in July. Destroying the chrysalis is the most certain means of checking the increase of the insect, and if, as is probably the case, the eggs are deposited on the shoots, washing with soap and water, with a scrubbing brush, might be resorted to if the insect prove troublesome.

The caterpillar of the large pear-tree asatyges (*Astyages hemerobiella*), though in general of rare occurrence, sometimes appears in

great numbers, and by consuming the parenchyma of the leaves, seriously injures the tree. When full grown it is about $\frac{1}{2}$ inch in length, and is surrounded by a nearly cylindrical blackish case, which, being open at both ends, allows of the insect protruding the fore part of its body when feeding, or travelling from place to place. In attacking the leaf, it perforates the cuticle, and by consuming the parenchyma, forms a circular patch about $\frac{1}{2}$ inch in diameter. This being effected, it removes to another part and repeats the operation. Hand-picking appears to be the only means of checking the increase of this insect.

The caterpillars of the pear moth (*Tortrix angustiorana*) attacks the fruit, concealing itself beneath a delicate web formed in the eye of the pear, upon the rind of which it feeds. Little can be done to prevent the mischief done by this insect, except by removing and destroying the maggot whenever it is discovered. All dead leaves near the tree should likewise be burned, as it is not unlikely that the eggs may be deposited upon the foliage.

THE QUINCE (*Cydonia vulgaris*, Pers., *Pyrus Cydonia*, L.—*Icosandria Di-Pentagynia*, L.; Rosaceæ, J.; Pomaceæ, Lind.) is a low, deciduous tree, of a crooked, branching, irregular habit of growth, and a native of the south of Europe. It derives its generic name from Cydon, the modern Canea, near which the tree grew in great abundance.

The fruit, which is powerfully odoriferous, and, in its raw state, acid, astringent, and unfit for eating, is principally used for making an agreeable ice, quince marmalade, and other preserves, as well as to give briskness and flavour to apple pies and tarts.

The tree itself, as already mentioned, is much employed as a stock for certain varieties of the pear which are intended to be trained as dwarf pyramids, or espaliers.

The principal varieties cultivated for the fruit are:—

1. **APPLE-SHAPED QUINCE**—syn. Orange Quince, Coignassier à fruit pomniforme, Coing-pomme of the French.—*Leaves* oval, or ovate, downy beneath. *Fruit* roundish, about $2\frac{1}{2}$ inches in diameter, of a rich golden colour. Very productive, and ripening in a less favourable climate than the other sorts.

2. **PEAR-SHAPED QUINCE**—syn. Coignassier pyriforme, Coing-poire of the French.—*Leaves* oblong-ovate, downy beneath. *Fruit* rather larger than in the preceding, pyriform, or

sometimes roundish with a short neck, more or less ribbed towards the eye, of a somewhat paler colour than the apple-shaped, and ripening later.

3. **PORTUGAL QUINCE**—syn. Coignassier de Portugal of the French.—*Leaves* very large, broad oval, or ovate, downy on the upper side, very downy beneath. *Fruit* very large, about 4 inches in length, and 3 to $3\frac{1}{2}$ inches in diameter at the widest part, from which it is most elongated towards the stalk, tapering more abruptly towards the eye, where it again projects, forming irregular ribs. Skin thickly covered with gray wool, beneath which it is deep yellow. Flesh more tender, juicy, and much better for every purpose than that of the other sorts.

The tree is taller and more vigorous than in the apple-shaped and pear-shaped varieties, but is not quite so hardy, and bears less abundantly. It is frequently planted for the ornamental appearance of its flowers and fruit; also, from its vigorous growth and forming thicker annual layers of wood, it is well adapted for stocks for the pear.

The quince succeeds in almost any soil, but prefers one of a rich, somewhat light, and rather moist nature; heavy clays and dry, sandy soils, are but ill suited to its growth. To ripen the fruit properly, a situation not shaded by tall trees, and open to the sun on the south, east, or west side is necessary; but in any case, and particularly in cold and backward localities, a southern aspect is highly desirable.

Propagation may be effected by seeds, but as these seldom ripen in this country, cuttings and layers are the modes generally adopted. Cuttings should be made early in autumn, from wood of the same year, and, if possible, with a small heel of two-year old wood. They should be planted 1 foot apart, in rows $2\frac{1}{2}$ feet from each other, and if watered in dry weather, they soon strike root. If intended for stocks, they may be grafted or budded the second or third year after they are put in, if not, they may remain in the nursery for two or three years, and may then be planted where they are to remain. The best plants are obtained in this way, though not so quickly as by layering.

In propagating by layers, the stem of a quince tree is cut down in autumn to form a stool, and the young shoots which are put forth in consequence are layered in the autumn

of the following year, leaving two buds above ground. When these buds have made shoots a few inches in length, the top of the weaker one should be pinched off, and in about two weeks after, it may be cut back to the lowest two leaves. The remaining shoot must be trained upright. In autumn the layer should be taken up, the shoot which was shortened back in spring cut off close to its base, and any laterals which may have pushed cut back to two eyes. The rooted layers formed in this way may then be planted out in nursery rows. Instead of laying down the shoots in the above manner, the following procedure is generally adopted near Paris:—The stem of a young and vigorous tree is cut down in spring to within 8 inches of the ground, and in the following year, when a number of good shoots have pushed, mould is thrown in amongst them so as to cover the top of the stump, but leaving their tops above ground. The earth is then formed into a truncated cone, and a basin is made in the centre. The shoots soon strike root, and may, for the most part, be severed from the stump and planted in the autumn of the succeeding year. The stool will soon produce fresh shoots which may be treated in the same way, and young plants may thus be obtained every two years.

If intended for stocks, the young plants should be shortened back to 18 inches on being planted out in the nursery rows, but if for standards, they ought to be trained upright and at full length to a rod. Those for stocks should, in the summer after planting, have the lateral shoots cut entirely off to the height of 6 inches above the ground, in order to form a clean stem near where they are to be worked. But those not propagated for this purpose should have the lower laterals shortened to two eyes, and the points of the remainder must be pinched to determine the sap towards the leading shoot. In two years they may be taken up, after the fall of the leaf, and transplanted to wider distances apart, or planted where they are to remain. In the latter case, they may be placed 15 feet apart if several are planted.

The varieties being readily propagated by cuttings and layers, budding and grafting are seldom resorted to.

Pruning and Training.—The quince is not one of those trees which naturally grow with a strong, erect stem, such as is most desirable for a standard; and to rear it with one of this description requires considerable attention,

otherwise it is apt to grow up with long flexible shoots, inclined to branch and twist. A tree, planted where it is intended to remain, should be allowed to grow at freedom for a season. It ought then to be cut back, in autumn, to within 18 inches of the ground. Several shoots will push, the strongest of which should be trained upright to a rod, and shortened a little at every autumn pruning. If the one highest up be the strongest, so much the better, if not, the shoot or shoots above it must be rubbed off; and those below it should be pinched, when 1 foot in length. Laterals on the young upright ought to be allowed to grow during the summer; but they should be shortened to a few inches at the autumn pruning; at the same time, the shortened shoots between the base of the one trained upright and the ground, ought to be cut clean off. By continuing to train the young shoot quite upright, an erect stem will be insured, and, by allowing plenty of laterals to grow, and by gradually reducing them, the stem will be rendered strong enough in course of a few years to be self-supporting. When the stem has attained the required height, the head should be formed as directed for the apple and other fruit trees. After the principal branches have been originated, very little pruning will be necessary. Over-luxuriant shoots are apt to start up; these should be looked for, and checked at an early period of their growth, and weak spray and cross shoots ought to be cut off.

The fruit ripens in the end of October or beginning of November, and may hang on the tree as long as there is no danger of frost. After gathering, it should be wiped with a clean cloth and laid out on shelves, or on well-dried straw, in some cool place apart from other fruits, to which it is apt to communicate a disagreeable flavour. It does not keep longer than a month or six weeks.

THE MEDLAR (*Mespilus germanica*, L. — *Icosandria Di-Pentagynia*, L.; Rosaceæ; Pomaceæ, Lind.) is a low, deciduous tree, a native of England, France, Germany, and the south of Europe, where it grows naturally in hedges, woods, and copses. Its fruit, which is hard, acid, and unfit for eating till it loses its green colour and *blets*, or begins to decay, when it acquires an agreeably acid, somewhat astringent flavour, is generally eaten raw, but is also occasionally made into preserves along with sugar.

The varieties worthy of cultivation are:—

1. NOTTINGHAM MEDLAR—syn. Common, Small-fruited.—*Fruit* about 1 inch in diameter, obovate, of a bright yellowish brown, spotted with russet, of a rich, brisk, sub-acid flavour. The best sort as regards quality. The tree is of upright growth, in which respect it differs from the other sorts; its leaves also are much smaller.

2. DUTCH MEDLAR—syn. Large Dutch, Broad-leaved Dutch, Large German, Large-fruited German, Blake's Large, Nèflier à gros fruit, Nèflier à très gros fruit, Nèflier monstrueux, Nèflier de Hollande à gros fruit.—*Fruit* very large, about 1½ inch in diameter, grayish green previous to bletting, bright reddish brown when ripe. Flavour good, but inferior to that of the Nottingham. It is cultivated on account of the large size of the fruit.

3. STONELESS—syn. French Medlar, Nèflier à fruit sans noyau, Nèflier à fruit sans pépins.—*Fruit* small, about ½ inch in diameter, obovate, of a russet brown colour when ripe, and without stones. Inferior in flavour to the preceding sorts, but keeps longer, and is worthy of cultivation on that account.

The medlar is raised from the stones or seeds, which should be taken out as soon as the fruit is ripe, and sown immediately. They usually take two years to come up; and afterwards the seedlings should be attached to a strong stake in order to preserve a tolerably upright stem. Seed is only sown with the view of obtaining new varieties or stocks, the varieties being propagated by budding or grafting upon the wild medlar, pear, quince, or whitethorn. The latter kind of stock is preferred on the Continent, and is perhaps the best where the soil is sandy and dry; the quince is the best in moist soils, as its roots extend near the surface; and the pear, grafted standard high, gives a straight stem and a more regular appearance to the tree, for which it is probably the best stock in ordinary soils. Any of the usual modes of grafting may be employed, but, for that purpose, scions should be chosen from shoots of the previous summer's growth, and care be taken to cut off the extremities where the flowers appear, otherwise they will not succeed. When budding is resorted to, the mode with a dormant eye is preferred.

With regard to soil, the medlar is not particular, growing in any that is not arid or swampy, but it produces the largest and best fruit in rich, loamy, somewhat moist ground.

The tree may be trained as a standard, and the Nottingham and Stoneless varieties may even be formed into productive pyramids, in the same way as the pear. The Nottingham medlar, which takes an upright growth, requires very little pruning; but the Dutch medlar, and others of similar crooked growth, will require some regulation to prevent the branches from crossing and rubbing against each other. More than this need not be attempted, for the branches are naturally so inclined to assume an elbowed form, turning frequently at right angles in any direction, that to keep them straight would be almost an impossibility, and, in our opinion, would only spoil the characteristic rusticity of the tree.

The fruit should remain on the tree until the end of October, or beginning of November; and when the stalk parts readily from the bearing shoots it should be gathered on a dry day, carried to the fruit-room, and laid out upon the shelves. It is a good plan to dip the end of the stalk in a solution of common salt, for this tends to prevent the attacks of a minute fungus which usually commences at that part and extends to the fruit, which it renders useless. Some place straw beneath the medlars, but unless perfectly clean and dried upon a kiln, or in the sun, it encourages mouldiness, and is apt to give them a musty flavour. The fruit should be looked over from time to time, and any that is affected with fungus must be at once removed, otherwise it will taint the rest. It becomes fit for use in two or three weeks after gathering, and may keep good till January.

CHAPTER XVII.

THE PLUM, CHERRY, APRICOT, PEACH, NECTARINE, AND ALMOND.

THE PLUM (*Prunus domestica*, L.—*Icosandria Monogynia*, L.; *Rosaceæ*, J.; *Drupaceæ*, Lind.) is a low, deciduous tree, a native of Britain, as well as of most other parts of Europe and the mountainous parts of Asia.

The fruit forms a valuable addition to the dessert, both in respect to its rich flavour and beautiful appearance, which is not a little heightened by the delicate bloom with which the skin is covered. The fruit of some sorts,



Drawn by M^r Withers.

Engr^d by Tho^s Dick.

*1 Coes Golden Drop 2 Reine Claude Violette
3 Kirkes 4 Jefferson*

such as Coe's Golden Drop and the Ickworth Impératrice, may, with a little care, be preserved for months in a fresh state for the desert, a quality which is not possessed by any other of our cultivated fruits with juicy flesh, excepting the apple and pear. For pies, tarts, and various preserves, the fruit is also held in high estimation, and from some of the varieties the prunes of the shops are prepared. On the Continent, a spirit analogous to the kirschwasser, and sometimes called by that name, is also distilled from the fruit.

The cultivated varieties are very numerous, some of them closely resembling each other; but, in many cases, the distinctive marks are evident. The following classification, it is presumed, will be useful in establishing the identity of the varieties, which by that means may be divided into eight sections, and these admit of a further subdivision, according to the shape of the fruit, *round* or *oblong*, and the *adherence* or *non-adherence* of the flesh to the stone.

CLASS I.—SHOOTS SMOOTH.

- | | | | |
|---------------------------------|---|---------------------------|------|
| a, <i>Leaves smooth above.</i> | { | Fruit Pale..... | § 1. |
| | | Fruit Purple or Red. § 2. | |
| b, <i>Leaves pubescent.....</i> | { | Fruit Pale..... | § 3. |
| | | Fruit Purple..... | § 4. |

CLASS II.—SHOOTS PUBESCENT.

- | | | | |
|---------------------------------|---|-------------------|------|
| a, <i>Leaves smooth above.</i> | { | Fruit Pale..... | § 5. |
| | | Fruit Purple..... | § 6. |
| b, <i>Leaves pubescent.....</i> | { | Fruit Pale..... | § 7. |
| | | Fruit Purple..... | § 8. |

The principal varieties are:—

1. BLEECKER'S GAGE—syn. Blücher's Gage, German Gage.—*Shoots* downy. *Leaves* downy above. *Fruit* large, roundish oval. Stalk 1 inch or more in length. Skin yellow. Flesh yellow, separating from the stone, sweet, and luscious. Ripe in September.

2. BLUE IMPÉRATRICE—syn. Impératrice, Impératrice violette, Véritable Impératrice, Violette.—*Shoots* smooth. *Leaves* oval, smooth above. *Fruit* middle-sized, roundish obovate. Stalk $\frac{3}{4}$ inch in length. Skin violet, streaked or netted with gold-coloured lines near the stalk, and elsewhere dotted with brownish yellow, the whole surface covered with a profusion of bloom. Flesh yellowish, adhering to the stone, juicy, sugary, and rich. Stone oval, a little flattened.

Ripe in October, and will afterwards hang for a considerable time on the tree, if on a wall and netted up. It may also be kept in a dry room till the middle of December. Good as a late dessert plum, and also for preserving.

The tree bears well as a standard in favour-

able situations; but it would require to be planted against an east or west wall in cold or northern parts of the kingdom.

3. BLUE PERDRIGON—syn. Brignole violette, Perdrigon violet.—*Shoots* smooth. *Leaves* slightly downy above. *Flowers* middle-sized. Petals roundish. *Fruit* middle-sized, roundish obovate. Stalk about $\frac{3}{4}$ inch in length. Skin purple, dotted with yellowish brown, covered with a light bloom. Flesh rather firm, partly adhering to the stone, greenish amber, very rich. Stone small, oval.

Ripe in the end of August and beginning of September. From this and the White Perdrigon, the famous Brignole prunes are made.

4. CHAPMAN'S PRINCE OF WALES.—*Shoots* long and smooth. *Leaves* oval, crenated, smooth above. *Fruit* very handsome, resembling an Orleans in outward appearance, and also in the quantity of its flesh.

Ripe in the end of August.

It may be used, like the Orleans, both for dessert and kitchen.

It was propagated from an old tree found in the grounds of Mr. Chapman, at Syon, near Brentford. The tree is vigorous and a great bearer. It differs from the Orleans in having smooth instead of downy shoots.

5. COE'S FINE LATE RED—syn. St. Martin, St. Martin Rouge, Violette Octoverpflaume, Catherine violette.—*Shoots* downy. *Leaves* smooth above. *Flowers* middle-sized. Petals roundish, concave. *Fruit* middle-sized, roundish, depressed at the ends. Stalk $\frac{3}{4}$ inch long, thick. Skin purplish red, sprinkled with gold-coloured dots, and covered with an azure bloom. Flesh pale amber, somewhat transparent, parting from the stone, crisp, and juicy, with a rich, vinous flavour when the autumn is fine.

Ripe in the end of October or beginning of November. This is the latest known plum of its size.

The tree is an excellent bearer as a standard, but will only ripen its fruit as such in the southern parts of the kingdom; elsewhere, those who are desirous of late supply should plant it against a wall.

6. COE'S GOLDEN DROP—syn. Bury Seedling, Coe's Imperial, Coe's Plum, Golden Drop, Golden Gage, New Golden Drop.—*Shoots* smooth. *Leaves* middle-sized, flat, oval, acuminate, crenated, smooth, shining, deep green. *Flowers* middle-sized. Petals roundish oval, imbricated. *Fruit* large, oval or somewhat

obovate. Stalk from $\frac{1}{2}$ inch to 1 inch in length. Skin light greenish yellow, freckled with rich spots of ferruginous red next the sun. Flesh greenish yellow, adhering to the stone, very rich, sweet, and delicious. Stone middle-sized, elliptic, sharp-pointed.

Ripe in the end of September. It is excellent for the dessert, and for preserving. Not the least of its merits consists in its keeping long after it has been taken off the tree, on the shelves of a fruit-room, suspended by the stalk inside a window facing the sun, or wrapped in paper and kept in a dry room. By the last method, the author of the *Guide to the Orchard and Kitchen Garden* states that he has eaten it exceedingly good twelve months after it had been gathered.

The tree is a rather shy bearer when young and growing vigorously; but, when fairly in a bearing state, it is often very productive, even as a standard, in the south of England; but to bring the fruit to perfection in the north of England and in Scotland, it requires a wall. An east or west aspect is suitable, but one inclining to south-west is still better. When it is compared with other plums that decay soon after they are gathered, and which are, consequently, lost if not used in that short time, and its excellence as a handsome, first-rate dessert plum, is taken into consideration, it must be concluded that in any part of the kingdom it is deserving of a wall.

This variety, represented in Plate I., is said to have been raised about the beginning of the present century, by Mr. Coc, a market-gardener, near Bury St. Edmunds, in Suffolk.

7. CORSE'S NOTA BENE.—*Fruit* large, round. Stalk $\frac{1}{2}$ inch in length. Skin dull purplish brown, covered with a light violet bloom. Flesh greenish, parting from the stone, juicy, sweet, and rich. Ripe in September.

The tree is a great bearer.

8. DAMSON—syn. Common Damson, Round Damson, Small Round Damson, Early Damson of some.—*Branches* spiny. *Shoots* downy. *Leaves* small, oval, pointed, smooth above. *Flowers* early, small. *Petals* oval. *Fruit* small, roundish oval, inclining to obovate. Stalk slender, scarcely $\frac{1}{2}$ inch in length. Skin bluish black, thickly covered with azure bloom. Flesh firm, yellowish green when well ripened, parting from the stone, acid, and astringent. Ripe in the end of September.

The tree is a great bearer. The fruit is much used for pies, and for preserving.

9. DENYER'S VICTORIA—syn. Alderton.—*Fruit* large, oval. Stalk about 1 inch in length. Skin red, covered with a fine light bloom. Flesh yellowish, parting freely from the stone, moderately juicy, with an agreeable flavour. Stone oval, flattish, and remarkably tender, so much so, that it may be cracked between the thumb and fingers. Ripe in the end of September. It is excellent for kitchen use, and may also be used for the dessert.

The tree is an extraordinary bearer as a standard, the branches being generally so loaded that they require to be supported.

10. DIAPRÉE ROUGE—syn. Imperial Daidem, Mimms, Roche Corbon.—*Shoots* smooth. *Leaves* rather large, oval, flat, crenated, downy above. *Flowers* large, occasionally semi-double. *Petals* roundish, concave, imbricated. *Fruit* large, obovate. Stalk about 1 inch in length, moderately thick. Skin light clear purple, thinly covered with a delicate azure bloom. Flesh dull, pale, greenish yellow, parting from the stone, moderately juicy, with an agreeable flavour. Stone rather large, irregularly oval. Ripe in the beginning of September.

The tree is a good bearer as a standard.

The fruit is very handsome, and excellent for kitchen use.

11. DRAP D'OR—syn. Mirabelle Double, Mirabelle Grosse, Yellow Perdrigon.—*Shoots* downy. *Leaves* small, oval, crenated. *Flowers* middle-sized. *Petals* roundish oval. *Fruit* smaller than that of the Green Gage, round. Stalk scarcely $\frac{1}{2}$ inch in length. Skin greenish yellow, marked with reddish specks next the sun. Flesh yellow, parting from the stone, sugary, and rich. Stone oval. Ripe in the middle of August, about a week earlier than the Green Gage; and this circumstance, as well as its intrinsic excellence, renders it highly deserving of culture as a first-rate dessert fruit.

The tree is of moderate growth.

12. DUNMORE.—*Shoots* smooth. *Leaves* smooth above. *Fruit* above the middle size, oval. Skin dull yellow. Flesh yellowish, parting from the stone, rich, and sugary. Ripe in September. A good, hardy, late plum.

13. EARLY ORLEANS—syn. Grimwood's Early Orleans, New Early Orleans, Wilmot's Early Orleans, New Orleans, Hampton Court, Monsieur Hâtif, Monsieur Hâtif de Montmorency.—*Shoots* downy. *Leaves* smooth above, or but slightly pubescent. *Flowers* larger than those of the Common Orleans; stamens shorter than the style, stigma large. *Fruit* similar to

that of the Orleans, but of a somewhat deeper violet, and ripening ten days or a fortnight earlier. It is excellent for kitchen use. On this account, and likewise from being an excellent bearer, it is highly deserving of cultivation. Indeed, where space admits of planting only two plums of the Orleans breed, one of them should be this.

14. FOTHERINGHAM—syn. Grove House Purple, Sheen.—*Shoots* smooth. *Leaves* smooth above. *Flowers* middle-sized, stamens short, petals roundish. *Fruit* middle-sized, obovate. Stalk 1 inch long. Skin purple. Flesh greenish yellow, parting freely from the stone, juicy, and rich. Ripe in the middle of August, a little before the Green Gage. According to Lindley, "this very useful and hardy plum has been in England for many years, having been cultivated by Sir William Temple, at his seat at Sheen, near Richmond, in Surrey, before 1700, whence it was called the Sheen plum."

15. GREEN GAGE—syn. Brugnion Green Gage, Isleworth Green Gage, Wilmot's Green Gage, Wilmot's Late Green Gage, Bradford Gage, Abricot Vert, Damas Vert, Dauphine, Grosse Reine, Grosse Reine Claude, Reine Claude, Sucrin Vert, Verte Bonne.—*Shoots* smooth. *Leaves* middle-sized, ovate, smooth above, crenated. *Flowers* middle-sized, petals somewhat obovate, concave at top, stamens shorter than the style, anthers reddish yellow. *Fruit* middle-sized, round, with a small suture extending from the base to the summit, where it terminates in a depression. Stalk from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length, of medium thickness, bent, inserted in a small cavity. Skin pale green, intermixed with a faint tinge of yellow, and, when well exposed on standards, it is sometimes russeted next the sun, interspersed with some ferruginous specks. Flesh pale green, mostly parting from the stone, a little pulp sometimes adhering, melting, juicy, luscious, exceedingly rich, without that sickly flavour which is often combined with the sweetness of other plums. Stone small, roundish oval.

Ripe in the middle or end of August. It is highly esteemed both for the dessert and for preserving.

The tree is generally an abundant bearer. The variety has sometimes been reproduced from the stone, but great care should be taken that no seedling of inferior flavour to the original should, in any case, be substituted for it.

16. GOLIATH—syn. Saint-Cloud, Steers's Emperor, Wilmot's Late Orleans, Caledonian and Nectarine of some.—*Shoots* very downy. *Leaves* smooth above. *Flowers* middle-sized, petals round. *Fruit* large, roundish oblong, flat or a little depressed at the ends. Stalk very downy; by this the variety may be readily distinguished from the Nectarine, with which it has been often confused, and which has a smooth stalk. Skin purple, covered with a rich azure bloom. Flesh firm, greenish yellow, coarse, adhering to the stone, neither rich nor of fine flavour, but only fit for cooking.

Ripe in the beginning and middle of September. A remarkably handsome plum, but that is almost its only merit.

17. HULINGS' SUPERB.—*Shoots* downy. *Leaves* large, downy above. *Fruit* as large as the Washington, roundish ovate. Stalk $\frac{3}{4}$ inch in length. Skin greenish yellow. Flesh pale greenish yellow, parting from the stone, rich, and juicy. Ripe middle of September.

18. ICKWORTH IMPÉRATRICE.—*Shoots* smooth. *Leaves* rather small, oval, smooth, of a shining dark green. *Fruit* middle-sized, obovate. Stalk about $\frac{1}{2}$ inch in length, of moderate thickness. Skin purple, traced with golden lines, some radiating in nearly a straight downward direction from the stalk, others disposed in a circle, the whole surface covered with a bright purple bloom. Flesh greenish amber, partly adhering to the stone, juicy, and very rich, till it begins to shrivel on the tree. Stone small, oval.

Ripe in the beginning of October, and it may be preserved till the following summer, if wrapped in paper and kept in a dry place. Besides being excellent for the dessert, it makes a very good preserve.

It was raised by Mr. Knight, whose object in raising this and some other varieties, was to produce a fruit containing sufficient saccharine matter to preserve itself without becoming reduced to a dry or nearly dry state, as the French plums frequently do. In order to effect this, he raised many plants from the Impératrice Violette and pollen of Coe's Golden Drop, "one of which," subsequently named the Ickworth Impératrice, he observes, "appears capable of being long preserved without any material trouble. In the autumns of 1829 and 1830, I selected a few plums of this variety, and having folded them in blotting paper, I put them into a paper bag, and suspended them in my apple chamber. In this situation

they all remained perfectly sound till the end of February or beginning of March, gradually but slowly becoming more shrivelled, and ultimately retaining a good deal of juice; and I entertain scarcely any doubt but that, with the aid of closed jars, I could have preserved them till midsummer, or longer."—(*Horticultural Transactions*, 2d series, vol. ii. p. 522.)

19. JAUNE HÂTIVE—syn. Amber Primordian, D'Avoine, Catalanian, De Catalogne, Early Yellow, Prune de Saint-Barnabé, White Primordian.—*Shoots* downy. *Leaves* small, elliptic, crenated, smooth above. *Fruit* middle-sized, obovate, tapering abruptly to the stalk, depressed on the summit. Stalk slender, about $\frac{1}{2}$ inch in length. Skin yellow, interspersed with small pale dots, and thinly covered with a whitish bloom. Flesh yellow, parting freely from the stone, sweet, and tolerably rich. Stone small, oval, flattened. Ripe in the end of July and beginning of August.

The chief merit of this is its earliness, on which account one or two trees may be planted in an orchard, or some shoots of another plum which is trained against a wall may be budded with it, for supplying a few dishes before the Royale Hâtive ripens.

20. JEFFERSON (Plate I.)—*Shoots* upright, slightly downy. *Leaves* middle-sized, oval, smooth above. *Fruit* large, roundish oval. Stalk about 1 inch in length. Skin dark yellow, speckled next the sun with purple and brownish red, covered with a thin bloom. Flesh deep orange, parting from the stone, some portions slightly adhering, juicy, exceedingly rich and sugary. Stone middle-sized, elliptic. Ripe in the second or third week in September.

The tree is an excellent bearer, and so much hardier than the Green Gage that in a bad season it will attain a greater degree of excellence than that variety, so unrivalled under favourable circumstances. The Jefferson is an American variety, raised by the late Judge Buel, in his garden at Albany. It is highly deserving of cultivation as a standard, and also merits a place upon a wall.

21. KIRKE'S (Plate I.)—*Shoots* smooth. *Leaves* smooth above. *Flowers* middle-sized; anthers reddish yellow, like those of the Green Gage. *Fruit* large, round. Stalk about $\frac{3}{4}$ inch in length, very little sunk at its insertion. Skin dark purple, with a copious bloom, through which some small golden specks faintly appear. Flesh greenish yellow, parting from the stone,

firm, juicy, and very rich, resembling that of the Purple Gage, to which this variety, on the whole, bears considerable resemblance, but differs in not being depressed on the summit. Stone middle-sized, broad oval, flattened, channelled along the back. Ripe in beginning and middle of September. This excellent sort was brought into notice by Mr. Kirke, of Brompton Nursery. The tree is a good bearer, though not so excessively prolific as some. It bears well as a standard, but deserves a wall where such can be afforded.

22. LARGE GREEN DRYING—syn. Knight's Large Green Drying.—*Shoots* smooth. *Leaves* large, broad oval, smooth above. *Flowers* large. *Fruit* large, roundish. Skin greenish yellow, with some reddish specks next the sun. Flesh amber-coloured, adhering to the stone, very sugary, and rich. Ripe in the middle and end of September, and will keep for a considerable time after gathering, especially if ripened in dry sunny weather.

The tree is a very strong grower, and but a moderate bearer, at least till it attains its full size.

23. MIRABELLE—Mirabelle Jaune, Mirabelle Petite.—*Shoots* downy. *Leaves* small, ovate, somewhat cordate at the base, on young shoots downy above. *Flowers* small. Petals roundish oval, shorter than the stamens. *Fruit* very small, roundish oval. Stalk $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length. Skin yellow, covered with a light bloom, and marked with reddish spots next the sun. Flesh orange yellow when fully ripe, nearly of an apricot colour, parting from the stone, sweet, and rich. Stone small, ovate, a little flattened. Ripe in the middle of August.

The tree is of small size, and bears very abundantly as a standard. The fruits are small but exceedingly numerous, being often in clusters. Although not of much value for the dessert, they make very rich preserves.

24. NECTARINE PLUM—syn. Caledonian, Howell's Large, Jenkins's Imperial, Louis Philippe, Peach Plum, Prune Pêche of some.—*Shoots* smooth. *Leaves* large, oval, flat or somewhat concave, smooth above. *Fruit* large, roundish when well grown, and not too thick on the tree, otherwise oval. Stalk from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length. Skin reddish purple, with a thin bloom which easily rubs off. Flesh dull greenish yellow, partially adhering to the stone, tolerably rich. Stone middle-sized, oval, compressed. Ripe beginning or middle of August.

Useful for the dessert and for preserving. The tree is a very great bearer, frequently so much so that, unless the fruit be well thinned, it cannot possibly attain perfection.

25. ORLEANS—syn. Old Orleans, Red Damask, Monsieur, Monsieur Ordinaire.—*Shoots* downy. *Leaves* large, ovate, crenated. *Flowers* early, large. Petals roundish, imbricated, slightly concave. *Fruit* large, roundish, depressed on the summit. Stalk about $\frac{1}{2}$ inch in length. Skin having a ground colour of dark purplish red, sprinkled with some pale red specks, the whole covered with a close bloom, giving it a fine Prussian blue colour, which is unequalled amongst, at least, the generality of other plums. Flesh yellowish green, firm, parting completely from the stone, tolerably juicy and sweet, but not very rich, though excellent for kitchen use. Stone small, oval, flattened. Ripe in the end of August.

The tree is a great bearer, and has long been extensively cultivated both on the Continent and in this country.

26. PERDRIGON VIOLET HÂTIF—syn. Perdrigon Hâtif, Moyeu de Bourgogne.—*Shoots* slightly downy. *Leaves* smooth above. *Fruit* middle-sized, about as large as the Blue Impératrice, roundish oval. Skin purple, interspersed with some yellowish brown lines and dots. Flesh yellow, green, or amber-coloured, parting from the stone when well ripened, sugary, rich, and excellent. Stone small, a little flattened. Ripe in the middle of August and before the Green Gage; but it will hang to shrivel on the tree, and it is then still more rich and sugary. It succeeds as a standard.

27. PRUNE D'AGEN—syn. Prune d'Ast, Prune d'Ente, Saint-Maurin, Robe de Sergent, Prune de Brignole of some.—*Shoots* smooth. *Leaves* middle-sized, oval, acuminate, bright green, slightly pubescent above. *Flowers* large, with roundish oval petals. *Fruit* middle-sized, longish obovate. Stalk about $\frac{3}{4}$ inch in length, a little sunk at its insertion. Skin purplish red next the sun, with a slight bloom near the stalk, light red where shaded. Flesh yellow, sweet, and when well ripened parting from the stone, which is middle-sized, oblong oval, pointed at the end nearest the stalk, and flattened. Ripe in the end of September.

A tolerably good dessert plum, excellent for preserving, and one of the best for drying, for which purpose it is extensively cultivated in the neighbourhood of the place from which it takes its name.

The tree is a very abundant bearer.

28. REINE CLAUDE VIOLETTE—syn. Purple Gage, Violet Gage (Plate I.)—*Shoots* smooth, short-jointed. *Leaves* middle-sized, smooth above, of a shining deep green, darker than that of the Green Gage. *Flowers* of medium size. Petals roundish oval, somewhat concave at the top. Stalk about 1 inch in length, thick. *Fruit* middle-sized, roundish, flattened at the ends. Skin violet, with yellowish dots appearing through a light bloom. Flesh firm, greenish amber, parting from the stone, sugary, rich, and excellent. Stone middle-sized, ovate, compressed. Ripe in the beginning of September, and will keep in dry favourable seasons till October.

The tree is a good bearer as a standard, and it deserves a place against a wall.

According to Sickler, this excellent variety originated in Tourraine.

29. QUETSCHÉ—syn. Common Quetsche, Turkish Quetsche, Quetsche d'Allemagne Grosse, Zwetsche, Zwetschke, Damask, Damas Gros, Damas Violet, Early Russian, German Prune, Prune d'Allemagne, Sweet Prune; Impératrice Violette and Impératrice Violette Grosse of many, Damas Violet and Damas Violet Gros of some.—*Shoots* long, smooth. *Leaves* downy above. *Flowers* late, middle-sized; petals oval, broadest at the base, where they imbricate each other. *Fruit* middle-sized, long, elliptic, projecting in the middle towards the suture more than to the back. Stalk nearly 1 inch in length. Skin purple, covered with a thick bloom. Flesh greenish amber, separating entirely from the stone, juicy, with a brisk acidity, which this climate does not change sufficiently to sugar to render the variety fit for dessert, but it is good for kitchen use and for preserving. Stone long, flat, sharp-pointed.

The tree is hardy, vigorous, and a great bearer, therefore proper for orchards. The variety is much cultivated in Germany and other continental countries, for preserving and making prunes.

The Quetsche is often raised from the stone, hence there are many varieties differing slightly from that just described. Such are the Hungarian and Austrian Quetsches, which are very good varieties.

30. ROYALE DE TOURS.—*Shoots* slightly downy. *Leaves* slightly downy above. *Flowers* early, rather large; petals roundish obovate; stamens long. *Fruit* middle-sized, roundish.

Stalk $\frac{1}{2}$ inch in length. Skin purple. Flesh amber-coloured, slightly adhering to the stone, but melting, luscious, rich, sugary, and very excellent. Ripe in the beginning and middle of August, a week or more before the Green Gage.

31. ROYALE HÂTIVE—syn. Miviam.—*Shoots* very downy. *Leaves* middle-sized, roundish oval, slightly pubescent above. *Flowers* rather large; petals oval, concave. *Fruit* middle-sized, roundish, rather widest near the stalk, which is thick, about $\frac{1}{2}$ inch in length, scarcely sunk at its insertion. Skin purple, netted with yellowish brown. Flesh yellowish, parting from the stone, sugary, rich, and delicious. Stone small, flattened, ovate. Ripe in the middle of August. Wasps and flies attack it in preference to other sorts, and with a determination which scarcely any protection can resist.

The tree is a good bearer, and ought to be in every collection, on account of the great excellence and earliness of the fruit.

32. SAINT-CATHERINE.—*Shoots* smooth. *Leaves* smooth above. *Fruit* middle-sized, obovate, with rather a deep furrow, or suture, along one side. Stalk $\frac{3}{4}$ inch to 1 inch in length. Skin pale yellow, with rich russety or ferruginous specks next the sun. Flesh firm, partially adhering to the stone, yellow, somewhat transparent, sugary, and rich. Stone small, oblong, pointed. Ripe in the middle of September. In France, some of the finest prunes are made from this sort.

33. SAINT MARTIN'S QUETSCHIE.—*Branches* spreading. *Shoots* smooth. *Leaves* middle-sized, oval, smooth above. *Flowers* rather large, with roundish oval, imbricated petals. *Fruit* middle-sized, ovate, or somewhat heart-shaped. Stalk about $\frac{1}{2}$ inch in length. Skin greenish yellow, covered with a light bloom. Flesh yellowish, parting freely from the stone, juicy, rich, and sugary. Stone small, ovate. Ripe in the end of October. It is, perhaps, the best very late plum. The tree bears well as a standard, but, where space can be afforded, it deserves a place against a wall or espalier, and could then be netted up for a late supply.

34. SHROPSHIRE DAMSON—syn. Long Damson, Prune Damson.—*Shoots* downy. *Leaves* downy above. *Fruit* obovate, of larger size and longer shape than the Damson. Stalk scarcely $\frac{1}{2}$ inch in length. Skin bluish black, with a copious azure bloom. Flesh yellowish green, rather adhering to the stone, acid, astringent, yet somewhat sugary; only fit for

kitchen use and preserving. Ripe in the middle of September, earlier than the Damson.

35. WASHINGTON—syn. Bolmar, Franklin, Bolmar's Washington.—*Shoots* slightly downy, reddish toward the extremity. *Leaves* very large, broad, oval, shining, slightly downy. *Flowers* large, petals roundish. *Fruit* very large, roundish oval. Stalk $\frac{3}{4}$ inch long, inserted in a wide, shallow depression. Skin dull yellow, obscurely streaked with pale green, and having a blush of pale crimson next the sun, when well exposed. Flesh yellow, parting freely from the stone, sweet, and luscious. Stone rather large, flattened, oval, pointed at each end. The tree grows vigorously to wood when young, and is then a shy bearer, but after it has commenced, it bears very abundantly, either as a standard or against a wall. In training, the branches should have plenty of room, otherwise its broad foliage cannot be properly exposed to the light.

Its first fruit was produced on a sucker from the original tree, in 1818. This sucker was purchased from a market woman by Mr. Bolmar, a merchant, at New York.

36. WHITE MAGNUM BONUM—syn. Yellow Magnum Bonum, Egg Plum, White Holland, Wentworth, Dame Aubert, Dame Aubert Blanche, Dame Aubert Jaune, Grosse Luisante, Impériale Blanche.—*Shoots* vigorous, smooth. *Leaves* very large, broad oval, acuminate, downy above. *Flowers* large, petals somewhat obovate. *Fruit* very large, oval. Stalk about 1 inch in length. Skin yellow, covered with a thin, whitish bloom. Flesh firm, adhering to the stone, pale yellow, juicy, crisp, but not rich. Stone elliptic, pointed at the ends. Ripe in September. This large handsome fruit is not adapted for the dessert, but it is excellent for sweetmeats and preserving.

37. WHITE PERDRIGON—syn. Perdrigon Blanc, Brignole, Maitre Claude.—*Shoots* vigorous, downy. *Leaves* oval, acuminate, tapering to the stalk, downy, of a shining deep green. *Flowers* rather large; petals ovate, cream-coloured; anthers large, yellow. *Fruit* middle-sized, obovate. Stalk $\frac{3}{4}$ inch in length, slender. Skin whitish yellow, strewed with ferruginous specks next the sun, and everywhere sprinkled with a fine white bloom. Flesh pale yellowish white, transparent, parting from the stone, firm, juicy, and rich. Stone small, elliptic. Ripe in the end of August.

This variety is extensively cultivated in

Provence, especially near the little town of Brignole, and is one of the sorts from which the famous Brignole prunes are prepared. It is also excellent for the purposes of the confectioner; and it is chiefly on this account that it deserves cultivation.

38. WINE SOUR—syn. Rotherham.—*Shoots* slender. *Leaves* oval, downy above. *Flowers* middle-sized; petals obovate, concave. *Fruit* small, but larger than a damson, obovate. Stalk $\frac{1}{2}$ inch in length. Skin purple. Flesh greenish yellow, partly adhering to the stone, near which it is tinged with red, and becomes so throughout when very ripe, juicy, and sub-acid. Stone long, elliptic, pointed. Ripe in the middle and end of September.

This variety is said to have originated in the neighbourhood of Rotherham, in Yorkshire.

The tree is a good bearer. Its fruit is excellent for preserving, and by some esteemed as the best of all plums for that purpose.

Selection of Eight Varieties.

Coe's Golden Drop.	Kirke's.
Early Orleans.	Purple Gage.
Green Gage.	Royale Hâtive.
Jefferson.	Washington.

Selection of Sixteen Varieties.

Blue Perdrigon.	Orleans.
Coe's Golden Drop.	Perdrigon Violet Hâtif.
Denyer's Victoria.	Purple Gage.
Early Orleans.	Royale Hâtive.
Green Gage.	St. Martin's Quetsche.
Ickworth Impératrice.	Washington.
Jefferson.	White Magnum Bonum.
Kirke's.	Wine Sour.

Selection for Cultivation on Walls.

Coe's Golden Drop.	Kirke's.
Early Orleans.	Purple Gage.
Green Gage.	Royale Hâtive.
Ickworth Impératrice.	Washington.

White Magnum Bonum.

Propagation.—Some kinds of plums are propagated by seed, others occasionally by suckers; but the usual mode of propagating the cultivated varieties is by budding and grafting. Propagation by sowing the stones is employed for raising stocks for plums, peaches, nectarines, and apricots. The Musele, White Pear plum, and St. Julien, are the sorts chiefly employed for stocks. For standards the Musele answers well.

The stones should be sown, as soon as taken from the fruit, in a bed of rich, sandy soil, placing them 1 inch apart, in drills 2 inches deep, and 9 inches or 1 foot asunder. Some recommend the stones to be dried a little in

the sun, packed in dry sand till November, and then sown. The French stratify the stones till spring, and then plant them out in rows. By either of these modes, the seedlings will be fit for transplanting into nursery lines in autumn. In doing this, the unripe extremities of the leading and side shoots should be cut off; the tap-root may also be shortened. Twelve months after this, they ought to be cut down to two buds above the surface. In the following spring both buds will likely push, but only one should be allowed to grow for a standard stem, or for being budded high or low as may be desired.

There are some kinds of plums which reproduce themselves more or less perfectly from the stone, and amongst these is the Green Gage; but whilst many of its offspring obtained in this way may nearly approach the parent as regards quality, yet great care should be taken that none be substituted for it in cultivation. If any one is but a shade inferior, and, consequently, might be considered an excellent fruit, still it ought not to be confounded with the original. Damsons are also frequently raised from the stone.

The plum is also propagated for stocks by layers and suckers, but for this purpose plants raised from seed are better, as they are less subject to throw up suckers, and constitute more lasting trees.

Budding and grafting are the modes usually adopted for propagating the varieties. Strong growing sorts intended for standards may be grafted or budded near the ground, and the shoot from the scion is reared for the stem. In the case of weaker growing kinds, such as the Mirabelle, it is better to allow the stock to grow up, and bud or graft it standard high. Some prefer budded plants, others those which are grafted; but, if properly worked, good trees can be obtained by either mode. Nurserymen usually have less ground-work on hand at the budding than at the grafting season, and therefore find it convenient to propagate at the former period. Besides, if buds should not take, the stocks can be grafted in the following spring. In order that the graft may form a sound union, attention to a few particulars are necessary. The scions should be taken off early in the season, say in January, or at least before the buds begin to push. At the same time, the stock should be headed down near to the place where the scion should be put on. If either the scion or the stock, or both, are

too far advanced when they are cut, success is rendered uncertain. Even if the graft should take, gum or canker is apt to ensue. The grafts of plums are more apt to fail than those of apples and pears; yet, when the stocks are early headed down and the scions taken off in good time, as directed, the grafts will generally succeed. We have known every one of the scions that were taken off in December succeed, whilst those taken off when the buds were expanding all died. In case of dry weather, it is a good plan to earth up the grafts above the clay, where, as in the case of dwarfs worked near the ground, this can be done.

In budding, great care must be taken that wood and not blossom buds are inserted, and in grafting, it is necessary to see that there are wood buds on the scion. Occasionally, it may be desirable to propagate a particular variety, the shoots of which have scarcely any wood buds, except their terminal ones; and when such shoots must be employed for scions, the buds at the extremities should not be cut away; they must form the terminal bud of the scion.

Soil and Situation.—The plum will grow freely in any good, loamy soil, neither too dry, nor having a wet subsoil. In strong soils, the trees make vigorous shoots when the ground begins to get warm after midsummer, but the fruit is not so well-flavoured as in fresh, light soil. The roots extend nearer the surface than those of the apple and pear, and, therefore, they do not naturally require the soil to be so deep. Vicissitudes of moisture and dryness are very prejudicial to stone fruits, frequently causing them to gum; the cause of this should be avoided; therefore, the ground ought to be trenched rather deeply; for the amount of moisture in a deeply loosened soil is far more uniform than in shallow, untrenched ground. The subsoil, of course, should be well drained. With sufficient moisture, the tree will bear a southern exposure, which, of course, is the best for giving flavour to the fruit.

Planting.—The ground having been prepared as already directed for the apple and pear, the distance between the trees requires, in the next place, to be determined. In the open ground, for standards, half standards, and dwarfs, this may be from 20 to 25 feet between the rows, and about 20 feet apart in the rows; or, if planted in the quincunx manner, which is the best, the distance between the

rows being 24 feet, that of the trees in the row will be 20 feet 9½ inches, very nearly. If the rows are 20 feet apart, the trees in the row, when planted in quincunx, will be 17 feet 3¼ inches; in this way the trees will be in line in all directions, which is an advantage in cropping the ground. If espaliers are afforded for plums in a quarter, they may range about 12 feet apart from row to row if the extent of ground is limited, but if not, 15 feet should be allowed; in either case the distance between the trees in the row ought not to be less than 15 feet. Against walls, the distance may be from 15 to 20 feet, according to the richness of the soil.

The manner of planting the tree is similar to that recommended for the apple and pear. Mulching, in case of dry weather, is advantageous to recently transplanted trees in general, and should be particularly attended to in the case of the plum; for, if the root fail to supply enough of sap to the tree in dry weather, gumming is apt to ensue; the more uniform the supply of sap, the more healthy will be the tree, and the less will be the danger of gumming taking place. The supply of sap cannot be uniform unless the moisture of the soil about the roots is steadily maintained; and the best means of doing this is by mulching.

Pruning and Training.—For standard trees, where under-cropping is intended, the height of the stem should not be less than 6 feet. Therefore, a stem should be reared above that height on the same principles as recommended in the case of the apple and pear, and it should be cut back in autumn to three buds above 6 feet. In the following summer, three shoots from these buds should be allowed to grow at full length, except when it may be necessary to check one that may be too strong for the others. Depressing early the strongest and elevating the weakest may have the effect of maintaining the equilibrium; if not, the points of the strongest must be pinched, but not till they have extended more than 1 foot. Towards September, the three shoots should be so disposed as to have an equal divergence. Cut them back, each to about 1 foot in length; and, from each of the three so cut back, encourage two shoots in the following season, during which maintain an equality among all the six shoots thus originated for forming the six principal limbs of the tree. After this, it will only be necessary to check all over-luxuriant shoots, and to keep the head of the tree

clear of branches that cross and would rub against others. If the shoots, generally, are seen to be growing very luxuriantly, it would be well to pinch their tops about midsummer; otherwise, when very long shoots are allowed to be made, nearly their whole extent is apt to be naked in the course of a year or two.

For trees against walls, unless the latter are very low, the fan mode is the best; for, being a stone fruit, the branches of the plum are more apt to die off than those of the apple and pear, and, that being the case, fan-training admits of vacancies being filled up by a redistribution of the branches.

When the plum is planted in a rich border it grows very vigorously, as soon as its roots get well established. It therefore requires to be particularly watched. If any weak shoots have been previously formed, they are of little use — they cannot be depended on for constituting any of the principal branches of the tree, for they have little power of drawing sap compared with the young vigorous shoots which the tree subsequently emits. With these, the two or three small, weakly, old branches have no chance, the latter indeed would gradually acquire strength if the former were cut out, but doing so would be likely to occasion gumming; and, if the plan were adopted, the tree would be long in covering the wall. It is therefore better to dispense with the weak shoots which cause disparity, and select shoots of good vigour for the origin of the principal branches. These should be laid off as directed in the chapter on training. The shoots of the plum do not require to be shortened at the winter pruning if their extremities are well ripened, except where branches are required. Numerous shoots will push, more especially from the upper sides of the branches. These shoots must be pinched below the sixth leaf, when they have made as many. They should be shortened at the winter pruning, and, on the portions left, fruit-buds will form, or shoots push. In the latter case, pinching must be resorted to as before. When spurs grow too far from the wall, they must be cut back; but those on the lower branches should be allowed to extend a little more than those on the upper side, in order that as much or rather more foliage may be in connection with the lower branches as there is on the upper; for, otherwise, most of the sap would be drawn to the latter, and the lower branches would ultimately perish. In proportion to

the equal distribution of the sap, so will be the health, duration, and fruitfulness of the tree; and the sap can only be equally distributed by each branch being furnished with an equal amount of foliage. From not employing means to insure this as much as possible, many plum trees on walls have been ruined. Where any shoots give indications of excessive vigour, they should be early kept in check. The young summer shoots in the upper part of the tree should receive their summer pruning before those in the lower part. It is frequently the case, that shoots in the central part of fan-trained plum trees are inclined to become excessively vigorous. As they cannot well be much inclined from their upright position without crowding those on the sides, their vigour may be considerably repressed by pinching, or cutting out nicely with a sharp penknife the growing point. This will cause some delay in the progress of the shoot, and, consequently, in the production of leaves; those already formed will, however, become larger than if the above operation had not been performed. Therefore, in addition to other means tending to diminish excess of vigour, some of the leaves should be clipped across the middle with sharp scissors. Every third leaf may be safely clipped in this manner; if that is not likely to prove effectual, every alternate leaf may be so treated; and, in obstinate cases, we have seen every leaf on a shoot clipped half away with no injurious results, but, on the contrary, with the most beneficial effects, inasmuch as wood of only the requisite thickness was obtained, instead of a shoot too thick to be retained in that part of the tree, and which would consequently have to be cut away at the winter pruning. Thus, a considerable waste of vegetation is avoided, as well as the probability of inducing disease; for gumming frequently takes place when very strong shoots are cut off.

Where the horizontal mode of training is adopted, whether on walls or espaliers, the first course should be 1 foot from the ground, and the others 9 inches apart. Care, however, must be taken to originate the branches 4 or 5 inches below the horizontal line, along which they are intended to be trained. If this be done, the branches will not be so liable to die off as if they were taken at right angles from the upright stem, which in training stone fruits should never be the case.

Other Culture.—The roots of the plum tree

run near the surface, and, on this account, the ground must either be dug every year, or not at all. Trees have been known to thrive very well where the ground was regularly dug for vegetable crops; but, on its being left undug for two years, the roots made great progress towards the surface, and, on again digging the soil for cropping, the trees suffered much from a vast number of young roots, which had been formed at less than a spade's depth from the surface, having been cut in the operation. Suckers are very apt to spring from the roots of the plum, and frequently a long way from the stem. They should therefore, in this case, be laid bare, and the suckers taken closely off. Suckers are more apt to push from trees that have sickly foliage or diseased stems, than from such as are in all respects healthy. The under side of the foliage is sometimes entirely covered with aphides, and, when this is the case, of course the tree cannot long remain healthy, however well it may be circumstanced in other respects. Every possible means should therefore be adopted to keep the foliage clean; and, at the same time, in order that it may be naturally healthy, the roots must be duly supplied with moisture.

Gathering and Preserving the Fruit.—Plums should be allowed to remain on the tree as long as possible. Choice fruit ought to be gathered by the stalk without disturbing the bloom, especially if the fruit is of a variety intended to be kept for some time; for the bloom is doubtless a provision of nature for its protection from atmospheric influences and moisture. Such kinds as Coe's Golden Drop and Ickworth Impératrice may be kept for months fit for dessert, if gathered in dry weather, wrapped in paper, and laid in a dry, airy place.

Prunes are prepared in large quantities for exportation, especially in the south of France. Doubtless, plums ripened in a dry, warm climate are better adapted for this process than those grown in this country; nevertheless, in favourable and abundant seasons, good prunes could certainly be made in this country if the mode of doing so were properly understood. To induce the attempt being made, we give the following abstract from the *Arboretum Britannicum*, as to the best mode of preparing prunes.

The plums, gathered when ready to drop from the tree, are laid separately on frames, or sieves made of wickerwork or laths, and

exposed for several days to the sun, till they become as soft as ripe medlars. When this is the case, they are put into a spent oven, shut up quite close, and left there for twenty-four hours; they are then taken out, and, the oven having been slightly re-heated, are again put in when it is slightly warmer than it was before. The next day they are again taken out, and turned by slightly shaking the sieves. The oven is heated again, they are put in a third time, the oven being considerably hotter than it was the second time. After remaining twenty-four hours, they are taken out, and left till they get quite cold. They are then rounded, an operation which is performed by turning the stone, without breaking the skin, and pressing the two ends together between the thumb and finger. They are next put upon the sieves, which are then placed in an oven from which the bread has just been drawn, and the door having been closed, the crevices are cemented round with clay. An hour afterwards, the plums are taken out, and the oven is shut up, with a cup of water in it for about two hours. When the water is so warm as just to bear the finger in it, the prunes are again placed in the oven, and left there for twenty-four hours, when the operation is finished; and they are put loosely into small, long, and rather deep boxes for sale.

Diseases and Insects.—The plum tree, when managed properly, is seldom attacked by any disease except the gum, and by that rarely to an injurious extent.

Tortrix Woberiana, a small brown moth, sometimes lays its eggs on the bark, and the caterpillars, when hatched, penetrate into and feed upon the inner bark. Through the aperture thus formed, the sap escapes, and gum not unfrequently follows. Two generations of moths are produced in the same season, one about the beginning of June, the other in August or September. The presence of the larva is generally indicated by small heaps of red dust on the bark of the trees attacked. Introducing a wire into the hole made in the bark, and painting the stems with lime at the periods when the eggs are deposited, have been recommended for the destruction of the insect.

The plum saw-fly (*Tenthredo morio*) appears when the trees are in blossom, and deposits its egg in the calyx. The larva, as soon as it is hatched, penetrates into the young fruit and feeds upon the interior until the plum falls prematurely. It then buries itself in the

earth, and re-appears in spring as a moth. All that can be done is to collect and destroy the fruit attacked, with the view of preventing further attacks.

The copper-coloured weevil (*Curculio cupreus*) occasionally does considerable damage to the crop on the Continent, by cutting through the stalk of the young fruit, after it has deposited its egg within the plum. Collecting and destroying the fallen fruit appears to be the only practicable mode of preventing a repetition of the mischief.

The red grub of the plum (*Tortrix nigricana*) proves injurious by penetrating into and feeding upon the fleshy portion of the fruit, which, when thus attacked, generally ripens prematurely and falls from the tree. When full grown, the grub creeps out, and, selecting a crevice in the bark, spins itself a cocoon in which it remains during the winter, changing in spring into a pupa, from which the perfect insect emerges, in the end of May or beginning of June, and soon afterwards begins to deposit its eggs upon the fruit. Collecting and destroying the prematurely ripe plums which have fallen, and searching for the cocoons, are the only remedies. Aphides, red-spider, and thrips also attack the tree.

THE CHERRY (*Cerasus*, J.—*Icosandria* Monogynia, L.; *Rosacæ*, J.; *Drupacæ*, Lind.)—The cultivated varieties of the cherry are referred by some botanists, including De Candolle, to four species of the genus *Cerasus*, namely, *C. avium*, *C. duracina*, *C. Juliana*, and *C. caproniana*, the former a native of England, the others natives of the south of Europe, or introduced into it from Asia Minor. To which of these species the numerous varieties respectively belong has never, however, been satisfactorily determined; but, for all practical purposes, they may be considered as variations of but one type, and it is not unlikely that this is actually the case.

The fruit of the cherry being produced at an earlier period of the season than that of any other fruit-tree planted in the open ground, that circumstance, as well as the cool refreshing nature of its juice, renders it an universal favourite. The sweet kinds are highly valued for the dessert, where, also, their bright colour and glossy skin have a very ornamental effect. The acid, or sub-acid varieties are much used for pies, tarts, and in confectionery. The Morello is excellent for bottling, or preserving in brandy; and from a small, black variety,

especially in the district of the Upper Rhine, the Germans make the well-known *kirschwasser*. Griotte de Ratafia, a small sort of Morello, is employed for making the cordial *ratafia*; and a small, black, wild cherry is used in the distillation of the Italian liqueur *maraschino*. It may, however, be well to remark, that in the fabrication of the above liquors, the stones and kernels are pounded and distilled, or fermented with the pulp; and, as the kernels contain more or less of the prussic acid principle—that is to say, prussic acid, although in a diluted form—due caution should be exercised both in their fabrication and use. The Kentish, Flemish, and Montmorency varieties have the stalk so strongly attached to the stone, that the latter may be drawn out by it, so that the fruit may then be dried like raisins, in the sun, or in an oven.

By the French, the varieties of the cherry are divided into three principal divisions, namely, 1st. *Merisiers* and *Guigniers*; 2d. *Bigarreautiers*; 3d. *Cerisiers* and *Griottiers*.

The *Merisiers* are the wild cherries of the woods; the tree is tall and pyramidal, the branches horizontal, the fruit red, black, or white, with some degree of bitterness. The *Guigniers* are considered to be improved varieties of the preceding, the fruit being larger, heart-shaped, and having a soft, very sweet flesh.

The *Bigarreautiers* do not naturally assume a pyramidal form, and the extremities of the shoots are rather inclined to become pendulous, whilst the fruit differs from that of the Guignier in the flesh being crisp and firm. In this division are included the *Bigarreaux*, and many of the Heart cherries.

The *Cerisiers* are not so strong-growing as the preceding, and the fruit is more or less acid, the pulp being tender and juicy. The *Griottiers* are scarcely distinguishable from the *Cerisiers*, except by a bitterness which is combined with the acidity of the fruit. The May Duke, Kentish, and Flemish cherries belong to the *Cerisiers*; the Morello to the *Griottiers*.

The distinctions in the above mode of classification not being so well marked as to render its general adoption desirable, we proposed (*Horticultural Transactions*, 2d series, vol. i. p. 251) the following as a substitute:—

“The first class consists of cherries, of which the Bigarreau and Black Heart may be instanced as typical of the better kinds. The leaves are generally large, pendent, waved on

the margin, with sharp prominent veins beneath, coarsely serrated, of thinner texture and of a more yellowish green than those of the following class; buds pointed; flowers large, proceeding from wood of not less than two years old; petals loosely set, not forming a well expanded cup-shaped flower, like those of the May Duke, Kentish, &c.; stamens slender, and irregular in length, some being longer and others shorter than the style.

"The second class is composed of aqueous cherries, such as the May Duke, Kentish, and Morello. The leaves are generally smaller than those of the preceding class, and have their margins plane, with the veins beneath as they approach the margin almost buried in the parenchyma, which is thicker than in the other class. The petioles support the leaves erect, or at least from hanging loosely and pendent; the latter are deep green. The flowers expand widely, and the petals hang not loosely, but form a regular cup-shaped flower, with strong stamens, generally shorter than the style.

"The subdivisions of the first class are taken from the form and colour of the fruit, and require no further explanation.

"In the second class, as all the varieties are coloured nearly alike, no white, nor white and red fruit having yet been met with among them, the form of the fruit, the sweetness or acidity of its flesh, and the colour of the juice, constitute the distinctions of the sections."

CLASS I.—LEAVES WAVED ON THE MARGIN.

Division 1.—*Fruit heart-shaped or oval.*

- A, Colour uniform, dark red or black, 2 1.
- B, Colour pale yellow and red,..... 2 2.
- C, Colour uniform, pale yellow,..... 2 3.

Division 2.—*Fruit round or oblate.*

- A, Colour uniform, dark red or black, 2 4.
- B, Colour pale yellow and red,..... 2 5.
- C, Colour uniform, pale yellow, 2 6.

CLASS II.—LEAVES WITH THE MARGIN PLANE.

Division 1.—*Fruit roundish, heart-shaped.*

A, Flesh sweet.

- a, Juice pale,..... 2 7.
- b, Juice purple,..... 2 8

B, Flesh acid.

- a, Juice pale,..... 2 9.
- b, Juice purple,..... 2 10.

Division 2.—*Fruit round or oblate.*

A, Flesh sweet.

- a, Juice pale,..... 2 11.
- b, Juice purple,..... 2 12.

B, Flesh acid.

- a, Juice pale,..... 2 13.
- b, Juice purple,..... 2 14.

The most esteemed varieties of the cherry

are included in the following descriptions, which, it is presumed, will be sufficient to render their identification easy, and make their qualities better known.

1. **BLACK HEART**—syn. Spanish Black Heart, Ansell's Fine Black, Early Black, Guignier à Fruit Noir, Grosse Guigne Noire, Schwarze Herzkirsche, Schwarze Tauben Herzkirsche, Black Caroon of some.—*Branches* spreading. *Leaves* large, oblong, waved, coarsely serrated. *Flowers* middle-sized. Petals roundish, imbricated. *Fruit* tolerably large, blunt, heart-shaped, somewhat compressed. Stalk from 1½ to 2 inches in length. Skin nearly black. Flesh of a deep claret colour, half tender, that is, not so hard as in the generality of the Bigarreau tribe, nor so soft as in the Duke cherries; tolerably juicy and rich. Stone large, roundish ovate.

2. **BÜTTNER'S BLACK HEART**—syn. Büttner's Schwarze Herzkirsche, Büttner's Neue Schwarze Herzkirsche.—A good bearer, and having so much resemblance to the Black Heart, that it is scarcely distinguishable from that sort. It has, however, a more vigorous constitution, and therefore should be planted in orchards in preference to the Black Heart.

3. **KRONBERG BLACK HEART**.—This, according to the German pomologists, was raised from seed at Kronberg, in Saxony. It very much resembles the Black Heart; but, whilst the fruit is of the same size, the stone is smaller, consequently there is more flesh. The tree being a good bearer, the sort deserves a place in the orchard.

4. **TRADESCANT'S BLACK HEART**—syn. Tradescant's Cherry, Elk-horn, Elk-horn of Maryland, Bigarreau Gros Noir, Guigne Noire Tardive, Grosse Schwarze Knorpel Kirsche mit säftigen Fleisch.—This is an old variety, said to have been raised by John Tradescant, gardener to Charles I. It differs from the Black Heart in having leaves not so deeply serrated, petioles shorter, and flowers smaller. The fruit is about the same size, blackish, with minute stripes of dark red interspersed. Flesh firm, with a similar flavour to that of the Black Heart, and ripening about a week later. The tree is rather a shy bearer.

5. **WERDER'S EARLY BLACK HEART**—syn. Werdersche Frühe Schwarze Herzkirsche.—*Branches* spreading. *Leaves* oblong, coarsely serrated. Petioles of medium length and thickness. *Flowers* rather large, opening early. Petals obovate. *Fruit* large, obtusely heart-

shaped. Stalk about $1\frac{1}{2}$ inch in length. Skin black. Flesh purplish red, firm, juicy, and sweet. Stone middle-sized, roundish ovate.

The fruit ripens considerably earlier than the May Duke, and nearly as early as the Early Purple Guigne, from which it may be distinguished by its shorter petioles.

The tree is a tolerably good bearer; and, on the whole, it deserves cultivation where room can be spared, in order to furnish a supply before the May Duke comes in.

6. EARLY PURPLE GUIGNE—syn. Early Purple Griotte, erroneously.—*Leaves* oblong, pendulous, coarsely serrated, with long, somewhat slender hairs. Petioles furnished with two or more large, reniform glands. *Flowers* early. Petals oblong oval. *Fruit* above the middle size, heart-shaped. Stalk long. Skin of a shining dark purple. Flesh purplish, juicy, tender, and rich. Stone middle-sized, roundish ovate. The tree is of moderately strong growth, and a medium bearer. The principal merit of this variety is its earliness. It ripens, in the south of England, on an east or west wall, in the beginning of June, or about a fortnight earlier than the May Duke; and, that being the case, a tree of it will prove useful for an early supply.

7. KNIGHT'S EARLY BLACK.—This excellent sort was raised by Mr. Knight, about the year 1810, from a seed of the Bigarreau fertilized with the pollen of the May Duke. The tree is very similar in growth and foliage to the Black Tartarian. *Fruit* large, obtusely heart-shaped, with a shining, black, but somewhat uneven surface. Flesh deep purple, firm, juicy, and rich. Stone small compared to the size of the fruit, and nearly round. The fruit differs from that of the Black Tartarian in being more blunt at the apex, and having a shorter stalk. It is also earlier. It has ripened on a south wall about the middle of June, even before the May Duke.

The tree is a good bearer either as a standard or against a wall, on which it well deserves a place.

8. ADAM'S CROWN.—*Shoots* vigorous. *Leaves* large, oblong, coarsely and irregularly serrated. *Flowers* early, large. Petals roundish. *Fruit* middle-sized, obtusely heart-shaped. Stalk long. Skin pale red, mottled with darker red. Flesh white, soft for one of this class, juicy, rich, and sweet. It ripens on a standard in the first or second week of July, or in the last week of June upon a wall. Ripen-

ing as soon as the May Duke, it affords a contrast of colour with that sort. The tree is a good bearer.

9. BIGARREAU—syn. Bigarreau Gros, Bigarreau de Hollande, Graffion, Harrison's Heart, Italian Heart, Turkey Bigarreau, West's White Heart.—*Shoots* yellowish brown. *Leaves* large, oblong, somewhat waved, sharply but not so deeply serrated as some of this class. Petioles about $1\frac{1}{2}$ inch in length. *Flowers* middle-sized. Petals oval. *Fruit* large, roundish heart-shaped, slightly flattened on the side and at the apex. Skin of a clear waxy white on the shaded side, bright red mottled with amber next the sun. Flesh firm, pale yellow or nearly white, sweet, and rich. Stone small for a fruit so large, roundish ovate. It ripens in the end of July and beginning or middle of August, according to the season and situation.

The tree is vigorous, an abundant bearer, and succeeds well as a standard in the south of England; but, in the northern parts of the kingdom, it requires a wall.

10. BIGARREAU NAPOLÉON—syn. Bigarreau Lauermau, Bigarreau Wellington, Lauermau's Kirsche, Lauermau's Grosse Kirsche, Lauermau's Herzkirsche, Napoleon's Herzkirsche.—The tree very much resembles the Bigarreau as regards wood, leaves, and flowers. The fruit is about the same size, the flesh equally firm, and the flavour similar; but it is rather longer in shape, darker in colour, and ripens somewhat later. The Bigarreau, however, has, on the whole, the finer appearance.

The tree is a most abundant bearer, and is well deserving of cultivation either as a standard or upon a wall.

According to the Baron Truchsess, who wrote a work on cherries, this sort was obtained from the vicinity of Hanover, by himself and other pomologists, in 1791, under the name of the Grosse Lauermau's Kirsche; and he states that, in 1804, it existed in the collection of the Luxembourg, at Paris, under the designation of Le Gros Bigarreau de Lauermau. Since 1829, however, it has been better known as the Bigarreau Napoléon.

11. BOWYER'S EARLY HEART.—*Leaves* oblong, tapering to the point. *Flowers* large, opening very early. *Fruit* small or middle-sized, obtusely heart-shaped. Stalk long, bright green. Skin pale amber, mottled with red. Flesh white, tender, juicy, very sweet and rich. It ripens on a standard in the end of June, or first week of July.

The tree is an abundant bearer; and although the fruit is not large, a tree of the variety may be planted in an orchard on account of its hardiness.

12. DOWNTON.—*Branches* strong, spreading. *Leaves* rather large, oblong, acuminate, slightly waved. *Petioles* about $1\frac{1}{2}$ inch in length. *Flowers* large. *Petals* obovate, imbricated. *Fruit* above the middle size, scarcely so large as that of the Elton, and less pointed, being of a roundish heart-shape. *Stalk* about 2 inches in length, rather slender. *Skin* pale yellow where shaded, tinged and mottled with red next the sun. *Flesh* pale yellowish white, tender, juicy, and very rich. *Stone* middle-sized, roundish ovate. It ripens soon after the May Duke, and before the Elton. It therefore deserves a wall; but it bears abundantly as a standard. This and the Elton are so much superior to the Old Red and White Hearts, that these are no longer necessary to be cultivated, and therefore need not be described.

The variety was raised by Mr. Knight, but its parentage is uncertain. It is said to have sprung from a seed of either the Waterloo or Elton.

13. ELTON.—This very excellent variety was raised by Mr. Knight, in 1806, from a seed of the *Graffion* or *Ambrée* cherry, probably the Bigarreau, fertilized with the pollen of the White Heart. Being possessed of much merit, it deserves the particular description given in the *Transactions of the Horticultural Society*, 2d series, vol. i. p. 266:—

“Tree very strong and spreading; branches dark brown; shoots speckled with a silvery epidermis, on a ground of chestnut brown. *Leaves* very large, even exceeding those of the Bigarreau, to which, otherwise, they have a close resemblance. *Petioles* about 2 inches long, with large reniform glands near the base of the leaf. *Flowers* large, opening about the second or third week in April. *Petals* oval, waved, imbricated. *Stamens* slender. *Fruit* large, heart-shaped, less obtuse than that of the Bigarreau, than which it has a longer and more slender stalk, being sometimes $2\frac{1}{2}$ inches, but generally $2\frac{1}{4}$ inches in length. *Skin* of a very pale waxy yellow on the shaded side, mottled and dashed with red next the sun. *Flesh* whitish, rather firm, but not so much so as that of the Bigarreau, sugary, and very rich. *Stone* middle-sized, ovate.” Ripens in the beginning, middle, or end of July, accord-

ing to climate and situation. It is a good bearer, and highly deserving of cultivation either as a standard or against a wall. It is esteemed by many the very best cherry that can be grown.

14. FLORENCE.—Tree vigorous in habit, resembling the Bigarreau. *Leaves* large, oblong, tapering, somewhat cordate at the base. *Petioles* short, little more than 1 inch in length, with reniform glands close to the base of the leaf, and occasionally upon it. *Flowers* large. *Petals* obovate. *Fruit* very large, obtusely heart-shaped. *Skin* on the shaded side pale amber, mottled with red next the sun. *Flesh* firm, but less so than that of the Bigarreau, juicy, rich, and sweet. It ripens so as to form a succession to the Bigarreau, but requires a wall, except in warm parts of the kingdom; one with a west or south-west aspect will suit it.

The variety was brought from Florence.

15. BÜTTNER'S YELLOW — syn. Büttner's Gelbe Knorpel - Kirsche, Büttner's Wachs Knorpel - Kirsche. — *Leaves* small, oblong. *Flowers* early, middle-sized. *Fruit* middle-sized, roundish heart-shaped. *Stalk* about $1\frac{1}{2}$ inch in length. *Skin* of a uniform clear yellowish colour, without the least tinge of red. *Flesh* yellowish, firm, juicy, and sweet. *Stone* middle-sized, roundish ovate. It ripens in the middle or end of July. The tree is an abundant bearer. The fruit is not apt to be attacked by birds; and such has also been observed in the case of other cherries that never acquire any tinge of red. A tree of this sort may be planted as a standard in the orchard for the sake of variety.

The variety was raised by Büttner, of Halle, and produced fruit for the first time about 1803.

16. BLACK EAGLE.—This variety was raised at Downton Castle, about 1806, by Miss Elizabeth Knight, from a seed of an amber-coloured Bigarreau, fertilized with the pollen of the May Duke. The tree forms a roundish, spreading head. *Leaves* pendulous, with a somewhat wavy margin, so far resembling those of the tribe to which the female parent belongs, whilst they also partake of the thick, fleshy nature of the leaves of the other parent, the May Duke. *Flowers* middle-sized; *stamens* shorter than the style. *Fruit* middle-sized, roundish heart-shaped, blunt or somewhat depressed at the top, black when well exposed and fully ripe. *Flesh* tender, with a rich, dark purplish juice. *Stone* small, round. It ripens soon after the May Duke; and on account

of its good quality and abundant bearing, it deserves cultivation as an orchard tree.

17. **LATE DUKE**—syn. *Anglaise Tardive*.—Tree vigorous, with a spreading habit of growth, very different from the erect form of the May Duke. *Young shoots* yellowish where shaded, yellowish brown where exposed. *Leaves* larger than those of the May Duke, of thinner texture, and of a paler green beneath. *Flowers* middle-sized. Petals roundish oval. *Fruit* large, roundish heart-shaped. Stalk from $1\frac{1}{2}$ to 2 inches in length. Skin bright, shining red. Flesh amber-coloured, tender, juicy, and rich, but with more acidity than that of the May Duke, especially if not allowed to hang for a considerable time after it might be supposed, from its colour and softness, to be ripe. It ripens in August, a period of the season when most tender-fleshed cherries are over.

The tree is a most abundant bearer as a standard, and deserves a place upon a wall, where it can be netted up.

18. **BÜTTNER'S OCTOBER MORELLO**—syn. Büttner's September and October Weichsel, Büttner's October Zucker Weichsel.—*Fruit* middle-sized, roundish or oblate. Stalk slender, about 2 inches in length. Skin dark brownish red. Flesh pale red, tender, with an abundance of acid juice. It ripens in October.

The tree is hardy, and a good bearer. It is deserving of cultivation as the latest known cherry which may be used for pies and for preserving.

19. **MORELLO**—syn. Black Morello, Dutch Morello, Late Morello, Ronalds's Large Morello, Small Morello, Cerise du Nord, Griotte Orlianaire du Nord, Milan, September Weichsel Grosse.—The tree forms a round head, with slender, spreading, or pendulous branches. The two-year old wood is of a blackish chestnut colour. *Young shoots* yellowish brown. Buds roundish. *Leaves* small, acuminate, broadest about two-thirds from the base, slightly serrated; upper surface dark green, smooth, soft, but opaque. Petioles short, from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length, supporting the leaves without bending. *Flowers* large. Petals broadly obovate. Stamens strong, some of them as long as the style. *Fruit* large, obtusely heart-shaped, somewhat compressed on the sides, and slightly depressed on the apex. Stalk about 2 inches in length. Skin dark red, becoming nearly black when allowed to hang long on the tree. Flesh deep purplish red,

tender, very juicy, and acid. Stone large, oval, slightly pointed. It ripens in the end of July or in August, but may be preserved on a tree against a wall till October. It is one of the most useful sorts for preserving, and also one of the few that will bear well upon a north wall.

20. **CARNATION CHERRY**—syn. Crown Cherry, English Bearer of some, Cerise de Portugal, Grosse Cerise Rouge Pâle, Cerise d'Orange, Cerise Ronge de Bruxelles, Griotte Rouge Pâle, Griotte de Villenes, Hollandische Kirsche, Oranien Kirsche, Rothe Oranien Kirsche, Altendorfer Kirsche, Herteguine Kirsche.—*Leaves* late in expanding, moderately large, oblong, tapering to the point, remarkably ragged, and coarsely serrated. Petioles strong, about 1 inch in length. *Flowers* opening late; stamens shorter than the style. *Fruit* large, round or oblate. Stalk $1\frac{1}{2}$ inch in length. Skin bright red when well exposed, amber-coloured when shaded. Flesh of a pale amber colour, tender, juicy, and rich. Stone middle-sized, round. Ripe in the end of July. It is a good cherry, but cannot be highly recommended owing to the tree being rather a shy bearer.

The variety has long been cultivated in the gardens of this and other countries.

21. **BELLE DE CHOISY**—syn. Ambrée de Choisy, Cerise Doucette, Cerise de la Palembre, Griottier de Palembre, Schöne von Choisy.—Tree vigorous, spreading. *Leaves* large, coarsely serrated, of a shining, deep green. Petioles short, scarcely 1 inch in length. *Flowers* large; petals roundish; stamens shorter than the style. *Fruit* large, roundish, somewhat oblate. Stalk about $1\frac{1}{2}$ inch in length, but generally forking at about $\frac{1}{2}$ inch from its base, and bearing on them footstalks which are about 1 inch in length from the fork. Skin red, intermixed with amber colour. Flesh amber-coloured, tender, very rich and sweet. Stone middle-sized, round. Ripe in the beginning or middle of July. An excellent cherry as regards quality, but not so good a bearer as the May Duke and various others of this class.

This variety is said to have been found at Choisy, near Paris, about 1760.

22. **MAY DUKE**—syn. Early May Duke, Large May Duke, Early Duke, Buchanan's Early Duke, Benham's Fine Early Duke, Morris's Duke, Morris's Fine Early Duke, Thompson's Duke, Portugal Duke, Millet's Late Heart Duke, Coularde, Cerise d'Espagne,

Griotte Grosse Noire, De Hollande, De Hollande à Grandes Feuilles, Royale Hâtive; Griotte d'Espagne, Griotte Précoce, and Anglaise of some.—The trees are readily distinguished by their erect growth. *Leaves* large for this class, ovate, acuminate on the young shoots; those proceeding from spurs broadest about two-thirds from the base, abruptly acuminate, of thick substance, and of a shining, deep green. Petioles strong, on the young shoots about 1 inch in length. *Flowers* middle-sized; petals roundish or roundish oval, concave, imbricated; stamens strong, shorter than the style. *Fruit* large, roundish. Stalk long and slender. Skin dark red when well exposed, fully ripened, and proceeding from perfectly matured buds; but when the blossoms from such buds are killed, and the fruit results from later and weaker blossoms, it remains of a red colour. Flesh, when produced in perfection, red, tender, juicy, and rich.

Ripe on standards in the beginning, middle, or towards the end of July, according to season and situation; on walls in the end of June or beginning of July.

It is a good bearer, hardier than the Bigarreau tribe, and well adapted for forcing.

23. ROYAL DUKE—syn. Royale Tardive; Anglaise, Anglaise Tardive of some French authorities.—This is most probably one of the varieties which were formerly cultivated in this country under the names of Late Duke, Arch-Duke, or Late Arch-Duke. They appear, however, to have been all but lost, for under these names, the May Duke was generally the sort obtained. The variety under consideration was introduced from France, under the name of Anglaise Tardive, by the Horticultural Society of London; and a description of it is given in their *Transactions*, 2d series, vol. i. p. 283, from which the following extract will tend to identify the sort and prevent its being confused with others. or lost:—

“Tree, in regard to its upright growth, very similar to the May Duke; the leaves and flowers are also very like those of the latter; the glands on the leaf-stalks are somewhat larger and more decidedly reniform. Fruit large and very handsome, oblate, which form will readily distinguish it from the May Duke. Stalks moderately thick, about $1\frac{1}{2}$ inch in length, separating from a common peduncle which is elongated from about $\frac{1}{4}$ to $\frac{1}{2}$ inch, having frequently a leaflet produced on it.

Skin deep shining red, becoming dark, but not so black as the May Duke, when fully ripe. Flesh reddish, tender, juicy, and very rich. Stone middle-sized, roundish oval.”

It ripens about the middle or towards the end of July, after the season of the May Duke and before that of the Late Duke.

24. KENTISH—syn. Kentish Red, Common Red, Early Richmond, Pie Cherry, Sussex, Virginian May, Flemish of many, Kentish Drier of some, Cerise de Montmorency, Montmorency à Longue Queue, Muscat de Prague, Commune à Trochet of some.—*Shoots* slender, drooping. *Leaves* small, oval, acuminate, slightly serrated, of a deep shining green. Petioles short, purplish red, with two or more yellowish globose glands. *Flowers* rather large; petals roundish, concave; stamens shorter than the style. *Fruit* middle-sized, round or oblate. Stalk varying in length from less than 1 inch to $1\frac{1}{2}$ inch. Skin bright red, but sometimes acquiring a darker colour. Flesh pale, very juicy, and acid. Stone middle-sized, roundish. Ripe about the end of July.

The tree is an abundant bearer, and much cultivated as a standard, and sometimes upon a north wall.

The stone can be withdrawn along with the stalk from the fruit, leaving the latter whole so that it can be dried.

25. FLEMISH—syn. Kentish of some, Cerise de Kent, Cerise à Courte Queue, Cerise à Courte Queue de Provence, Gros Gobet, Gobet à Courte Queue, Montmorency à Courte Queue, Montmorency à Gros Fruit, Englische Weichsel, Yellow Ramonde Weichselbaum mit Kurzen Stiel, Double Volgers of the Dutch.—The tree grows more upright than that of the Kentish, but does not bear so abundantly; though, owing to this, the fruit is sometimes larger; it has a shorter stalk, but in other respects the fruits are similar. As the Kentish answers every purpose for which this is adapted, and is more prolific, it is the more extensively cultivated of the two.

Selection of Twelve Sorts for Cultivation as Standards.

Bigarreau Napoléon.	Kentish.
Black Eagle.	Knight's Early Black.
Black Heart.	Late Duke.
Büttner's Black Heart.	May Duke.
Downton.	Morello.
Elton.	Royal Duke.

Selection of Sorts for a South Wall.

Early Purple Guigne.	Knight's Early Black.
Elton.	May Duke.
	Royal Duke.

Sorts for a North Wall.

Kentish, Late Duke, and Morello.

Selection of Sorts for a Cottage Garden.

Elton. Late Duke.

Kentish. May Duke.

Propagation.—For stocks and for obtaining new varieties, the cherry is raised from the stone. Those of the small black or red cherries, are the kinds usually sown for stocks. For trees intended to be planted against a wall or espalier, stocks raised from the stones of the Duke cherries and those of the Morello have been recommended. For very dwarf trees, *Cerasus Mahaleb* has long been employed in France, and to some extent in this country, for being grafted or budded with the May Duke, Kentish, Morello, and analogous sorts; but this stock is not adapted for large-leaved, strong growing varieties like the Bigarreau. With regard to raising new varieties, Mr. Knight observed, that the cherry sported more extensively, when propagated from seed, than any other fruit which he had subjected to experiment, and he therefore concluded, that it was capable of being brought to a higher degree of perfection than it has ever yet attained; and he himself raised, by crossing, some of the finest varieties in cultivation. The stones, whether for stocks or new varieties, may be stratified till early in spring, when those that are beginning to germinate should be planted in drills, and covered over to the depth of $1\frac{1}{2}$ inch; or they may be sown at that depth, in light, sandy soil, immediately after the fruit has been gathered. In two years, the seedlings intended for stocks will be fit to plant out in nursery rows.

Budding and Grafting.—Propagation by these means is performed in the same way as in the case of the plum. Scions for grafting must be taken off early, and if so, provided the operation is well performed, there is little danger of failure; but if they are not cut until the buds have considerably advanced, the grafts frequently do not resist the effects of dry weather. We have seen vigorous shoots, with large pith, cut off for scions and stuck in the ground in January; and though in March, when grafted, the pith was discoloured, being of a dark instead of a light colour, yet they all succeeded, whilst scions cut off and grafted fresh, failed to a considerable extent, although treated with the same care in every other respect. It sometimes happens, that, in old trees of the May Duke class, every bud on the scions

is a blossom-bud, with the exception of the terminal one; this should therefore be preserved, otherwise failure is certain.

Soil and Situation.—The best soil for the cherry is a moderately rich, free, rather sandy loam, with a well-drained subsoil. Stiff, moist soils are unsuitable; and so, on the other hand, are dry, gravelly subsoils. The trees require a large amount of moisture, particularly the sorts with large leaves, such as the Bigarreau and Heart cherries. In free soils, the roots can more easily travel after moisture, but in clayey, or stiff loamy soils, when this is exhausted, they are fixed, as it were, in a compact, hard baked mass, from which they can draw no moisture. In dry, loose soil, on the contrary, there is considerable circulation of air, which, being charged with moisture at night, will afford a supply of that necessary element to the spongioles, not in abundance, it is true, but to a beneficial extent. A southern exposure is the best for the cherry; but the Morello and Kentish varieties will bear fruit useful for kitchen purposes on a wall with a north aspect. Other kinds will do very well on an east or west aspect; but for early use, it would be desirable to have one or two trees of the May Duke on a wall with a southern aspect.

Planting.—The soil must be well prepared and in good condition, but not freshly manured. It should be trenched between 2 and 3 feet deep, and if there is a stratum of loam below the surface soil, the latter ought to be trenched down to the bottom of the trench, and the loam brought to the top. The holes for the plants must be made large, and dug out nearly to the turned-down surface soil; the tree should be planted not amongst the loam, but in tolerably rich free soil, and if the latter is mixed with turfy loam so much the better. The method of planting the tree is the same as in the case of the apple, pear, and plum. The distance should vary according to the size which the variety usually attains, and according to the breadth of its foliage; for, if it have large leaves, it will evaporate much, and will require a larger space for its roots to travel in quest of moisture to make good that evaporation which, in dry weather, will be more than the amount of rain which falls upon the surface overhung by the branches. As standards, the Bigarreau tribe may be planted 30 feet apart, or even more in rich soil; the May Duke, Morello, and similar varieties, at 20 and 25 feet

apart. Against walls and espaliers, from 20 to 24 feet should be allowed for the Bigarreau, Elton, and Florence cherries, and from 15 to 20 feet for the May Duke and Morello.

Pruning and Training.—The cherry, as a standard, requires but little pruning after the stem has been reared and the six principal branches of the head originated. The stem ought to be grown so as to insure its tapering; and on this account, it is necessary that it should not be stripped of shoots and foliage. The temporary side shoots left should not, however, be allowed to attain too great a length; they ought not to be permitted to compete with the leader, but must be checked when likely to do so. Further, these shoots should not be more than two years old when they are cut close to the stem, in order that the wounds may heal the more readily and with less risk of gumming. As the leaves on the shoots of a young tree are usually large, a few shoots will deposit a considerable quantity of alburnum on the stem below them; and, consequently, in proportion to that amount, the stem will be thickened more beneath such shoots than above them. Hence, the requisite taper form will soon be obtained, and the side shoots dispensed with when one, or, at most, two years old.

The head should be formed as directed for the apple and pear, with this exception, that the first three shoots of the Bigarreau tribe may be shortened to 15 inches instead of 1 foot; two shoots from each should be encouraged, one situated at the end, the other 3 inches nearer the stem, so that there may be room for the branches to increase in thickness without pressing against each other, as this occasions gumming, as is also sometimes the case when two large limbs originate from two adjoining buds. After the principal branches of the head have been started, very little pruning will be required. It will be well, however, to see that the principal branches are maintained of as nearly equal strength as possible for a few years, and then the tree may be allowed to take its natural development, with the exception of cutting out shoots that would otherwise form cross branches.

In training against espaliers, the branches should be 1 foot apart; and, like those of the plum, they ought to be started from the stem with an upward course and then trained horizontally. In summer pruning, whilst the tree is young and requires foliage to assist in

making roots, the summer shoots may be allowed to grow to 1 foot or 15 inches in length, and should then be shortened to 3 inches. But the shoots on the upper branches must be shortened at least a week before those on the lower ones. The leading shoots, those at the extremities of the horizontals, need not be shortened. After the tree has been planted a few years, clusters of fruit buds will generally form round the bases of the shoots, and likewise on spurs along the branches. With regard to the winter pruning, very little will be required, presuming that the summer pruning has been well performed. The stubs left in shortening back the summer laterals should be cut back to within 2 or 3 inches of their bases, or to the first wood-bud beyond the fruit-buds above alluded to as likely to form at the bases of the shoots.

In training the cherry against walls, the horizontal mode may be adopted for those that are under 7 feet high, but those above that height will be sooner covered by the fan method. Whatever mode be adopted, care should be taken that the lower branches are vigorous. It is difficult to render a branch vigorous if it has originated in a weak shoot. A weakly stem cannot produce a strong shoot; therefore the young tree must be well established, and in a vigorous state, before shoots to commence the lower branches should be started.

The directions given for espalier training will apply to horizontal training against a wall, only the summer shoots ought to be shortened more, in order that the fruit may be produced near the wall.

The distance between the branches may be 9 inches for Duke cherries, and 1 foot for the Bigarreau kinds, their leaves being not only much larger than those of the Duke, but also more pendulous.

The Morello cherry requires a different mode of pruning and training from that which is applicable to other kinds, owing to its mode of growth and bearing. Its shoots are slender, and it bears on those of the previous summer's growth; sometimes all the buds along the shoot are blossom-buds, the terminal bud only being a wood-bud; therefore, at the winter pruning, such shoots ought not to be shortened. Further, as the fruit is borne chiefly on the young wood, a succession of such must be kept up. There ought, of course, to be a certain quantity of old wood to bear the

young, in fact, the shoots should be treated somewhat like those of the peach; they must be trained in summer to bear fruit in the following season, at the end of which they should be cut away, but, whilst bearing fruit, a young shoot ought to be trained to replace them. It is frequently the case that branches and shoots of Morello trees are overerowed, but this should be avoided, otherwise large and fine fruit cannot be obtained.

Protection. — Birds, and particularly the blackbird and thrush, are the greatest enemies to the cherry crop, and the only effectual means of protecting the fruit is by netting. This should be put over the trees so as not to confine the foliage. Although, in the case of wall-trees, it is necessary that the net should be well closed, so as to prevent ingress at top, bottom, and sides, yet when in doing so, the leaves are crowded against each other, the appearance and the effects are bad. The net should hang clear of the leaves; and this may be easily done by running a wire through hooks below the coping, and having another supported about 9 inches from the wall. If the netting be fixed to the former and drawn over the latter, the object will be so far attained. The netting will hang tolerably clear of the foliage, but it has yet to be fastened at bottom, and this should be done so that it may be readily loosened at any time when fruit requires to be gathered. Small stakes may be driven in to a uniform height, a stout wire fastened along their tops, and to this the net can be easily hooked. When nets touch the ground, they are liable to be spoiled, and become unsightly from being splashed with mud in rainy weather; it would therefore be better to fix wire netting upright to the stakes, close to the ground. For protecting espalier trees, wire netting, if only 1 foot in width, should also be used next the soil, and joined to such other kind of netting as can be afforded for protecting the rest of the tree. If wire netting be run along to the height of 1 foot, and so that its lower edge may touch the ground, a light netting, such as that made at Nottingham, may be thrown over the tree, and attached to the wire on both sides; for the material alluded to is so light that it will not press so as to crowd the foliage. By adopting some efficient means of protection, good crops of the sweet kinds of cherries may be obtained from walls; and this is more than can be said of standard trees, for on these, it is

scarcely possible to obtain a crop of perfectly ripened fruit, on account of the birds. If a supply can be obtained from espaliers, it is certainly better to grow the trees against these, and thus render the space they would otherwise have occupied on walls available for other fruits.

Diseases and Insects. — The cherry suffers little from either of these, when planted in a suitable soil and situation, and in other respects properly managed. The disease of most frequent occurrence is the gum, and this is rarely injurious, except in cases where it prevails to a very great extent. It is merely an exudation of the sap from a rent in the bark. The causes of the disease are various; it often arises from accidental wounds, unskilful pruning, or from the breakage of a branch. It sometimes occurs in consequence of too many branches being made to originate very closely together on the stem, and not unfrequently results from the tree having been worked on an unsuitable stock, or planted in too rich soil. In the latter case, the obvious remedy is to take up the tree and replant it in a poorer soil; but if this cannot be done, root pruning, which by limiting the supply of nourishment obtained by the roots will diminish the flow of sap, may be advantageously adopted with the view of checking the disease; but above all, vicissitudes of dryness and moisture at the roots should be prevented.

The slug-worm (*Selandria atra* of Stephens) occasionally attacks the leaves, causing considerable injury to the crop of the following year. It may be destroyed by the means already pointed out as applicable in the case of the pear. The caterpillars of the goat-moth (*Cossus ligniperda*) prove very destructive in some situations to trees of the May Duke breed, which they appear to prefer to the Bigarreau tribe. *Aphis cerasi* is sometimes found in great numbers on the leaves and young shoots, but it may be kept under by syringing with tobacco water, dusting with snuff, or fumigation.

THE APRICOT (*Armeniaca vulgaris*, Lam. — *Icosandria Monogynia*, L.; Rosaceæ, D.C.; Drupaceæ, Lind.) is a low, deciduous tree, a native of the temperate parts of Central Asia. It was introduced into Europe from Armenia upwards of a century before the Christian era, but there is no record of its having been cultivated in Britain before the year 1562.

The cultivated varieties are not numerous,

as will be seen by the following classification, in which the principal ones are enumerated:—

CLASS I.—KERNELS BITTER.

Division 1.—*Fruit small, round, early. Flowers small.*

Red Masculine.

White Masculine.

Division 2.—*Fruit large.*

§ 1.—Channel of the stone closed up. Flesh parting from the stone.

Large Early.

Roman.

Blotched-leaved Roman.

Royal.

Brussels.

Shipley's.

Almond.

§ 2.—Channel of the stone closed up. Flesh adhering to the stone.

Montgamet.

§ 3.—Channel of the stone pervious.

Moorpark.

Hemskirke.

CLASS II.—KERNELS SWEET.

Division 1.—*Flesh parting from the stone.*

Breda.

Angoumois.

Musch-Musch.

Turkey.

Division 2.—*Flesh adhering to the stone.*

Orange.

Of the above the most esteemed are:—

1. RED MASCULINE—syn. Masculine, Brown Masculine, Early Red Masculine, Abricot Précocce, Hâtif Musqué, Abricotin, Frühe Muscateller Apricose.—*Leaves* broad, roundish cordate, acuminate, coarsely serrated. *Fruit* small, roundish, concave at the base. Skin dull yellow where shaded, tinged with red next the sun. Flesh pale yellow, juicy, slightly perfumed, parting from the stone, which is roundish, and has a bitter kernel.

Cultivated chiefly on account of its being the earliest.

2. LARGE EARLY—syn. Gros Précocce, Abricot de Saint-Jean, De Saint-Jean Rouge, Gros d'Alexandrie, Grosse Frühe Apricose.—*Leaves* large, tapering more to the petiole than those of any other variety, generally auricled at the base. *Fruit* large, somewhat oblong, flattened on the sides. Skin pale orange where shaded, bright orange with some reddish russet spots next the sun. Flesh orange, juicy, and rich. Stone flattened, oval, channeled on the back, sharp at the point; kernel bitter.

This sort is valuable on account of its earliness, for it ripens before any other of the large sorts.

3. ROMAN—syn. Common, Gemeine Apri-

cose, Grosse Gemeine Apricose; Brussels and Turkey of some.—*Leaves* broad, cordate, crenated. Petioles about $1\frac{1}{2}$ inch in length, with some globose glands. *Fruit* above the middle size, somewhat oval, compressed. Skin dull pale orange, faintly dotted with orange red next the sun. Flesh pale straw colour, parting very readily from the stone, soft, and soon becoming mealy, especially if not gathered a little before it is fully ripe. Stone flat, oblong.

This variety was formerly much cultivated, as the tree is vigorous and a great bearer.

4. ROYAL APRICOT—syn. Abricot Royal.—*Shoots* strong, nearly as short-jointed as those of the Moorpark. *Leaves* large, roundish, generally auricled at the base. *Fruit* about the size of the Moorpark, roundish oval, slightly compressed. Skin dull yellow, slightly tinged with red next the sun. Flesh pale orange, juicy, and rich. Stone large, oval, blunt at the ends, parting readily from the flesh. Kernel slightly bitter. It ripens about ten days earlier than the Moorpark, to which it bears most resemblance.

This valuable variety was raised in the garden of the Luxembourg, whence it was sent to the Horticultural Society. It is not so subject as the Moorpark to die off by limbs.

5. MOORPARK—syn. Anson's, Dunmore's, Dunmore's Breda, Hunt's Moorpark, Oldaker's, Peach Apricot, Sudlow's Moorpark, Temple's, Anson's Imperial, Walton Moorpark, Abricot Pêche, De Nancy, De Nüremberg, De Württemberg.—*Shoots* strong, short-jointed. *Leaves* large, roundish, acuminate, concave, deep green. *Fruit* large, roundish, compressed, flattened on the summit. Skin brownish orange, interspersed on the side next the sun with brownish red specks. Flesh dull reddish orange, juicy, peculiarly rich, and excellent. Stone large, compressed, perforated near the edge from the base to the apex, so that a pin may be introduced. It is not liable to become mealy; but, in some unfavourable seasons and situations, it occasionally does not ripen thoroughly on the side next the wall, and in wet seasons it sometimes cracks.

This variety is the most extensively cultivated of any, and deservedly so. It is said to have been imported from the Continent by Lord Anson, and planted at Moorpark, near Rickmansworth, in Hertfordshire.

6. BREDa—syn. Amande Aveline, Ananas, Bredäische, De Hollande, Hasselnussmandel, Hollandische Orange Apricose, Persique, Brus-

sels of some.—*Shoots* moderately strong. *Leaves* broadly cordate, acuminate. *Fruit* small, roundish or somewhat obtusely four-sided at the base, the summit slightly depressed. Skin deep brownish orange. Flesh deep orange, parting very freely from the stone, very juicy and rich. Stone small, roundish. Kernel sweet, like that of a filbert.

Ripe about the beginning of August on a wall, and its perfection is considerably prolonged on standards.

7. ORANGE—syn. Early Orange, Royal Orange, Royal George, Royal Persian, Persian, D'Orange.—*Leaves* flat, pendulous, tapering. *Fruit* nearly spherical, downy, of a more intense bright orange colour than other apricots, interspersed with some minute specks. Flesh tender, bright orange in some seasons, adhering to the stone, juicy, but not highly flavoured. Stone middle-sized, larger than that of the Breda and more flat. Kernel sweet. It is chiefly useful for preserving. The tree is an abundant bearer.

8. TURKEY—syn. Large Turkey, Abrieot de Naney of some French authors.—*Shoots* strong, short-jointed. Buds not particularly prominent. *Leaves* middle-sized, roundish, acuminate, slightly concave, rather evenly serrated, dark green. *Fruit* rather large, nearly spherical, very handsome, deep yellow, with a number of brownish orange spots and blotches next the sun. Flesh pale yellow, firm, juicy, sweet, with a little acid, very rich and excellent. Stone separating freely, in figure like that of the Moorpark, but without the hole or pervious passage, as in that variety. Kernel quite sweet, like that of an almond. It ripens on a south wall about the middle of August, and in other situations may be prolonged till the end of the month.

9. MUSCH-MUSCH—syn. D'Alexandrie.—*Leaves* roundish, somewhat cordate, acuminate. *Fruit* small, roundish, from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch in diameter. Skin slightly downy, lemon yellow where shaded, deep orange tinged with red next the sun. Flesh somewhat transparent, parting from the stone, tender, and rich. Stone roundish, flattened. Kernel sweet.

The tree bears abundantly; and the fruit answers exceedingly well for preserving.

This variety is a native of the oases of Upper Egypt.

10. KAISHA.—*Fruit* rather small, roundish, slightly depressed on the summit. Skin slightly downy, pale citron-coloured where shaded, pale

orange tinged and marbled with red next the sun. Flesh of a clear citron colour, somewhat transparent, parting freely from the stone, tender, juicy, sugary, and delicious, like refined loaf-sugar combined with the apricot flavour. Stone small, roundish. Kernel sweet, like a nut. It ripens early.

This variety was sent to Mr. Warmington, by John Barker, Esq., from Suedia, in the pachalie of Aleppo, where, it is stated, there exist thirteen varieties with sweet kernels.

Propagation.—The apricot is propagated by seed, budding, and occasionally by grafting.

The mode by seed is adopted with the view of obtaining new varieties; and there are some sorts which reproduce themselves with considerable exactitude from the stone, and are accordingly propagated in that way. The Moorpark is one of these; and although the original variety should not be lost sight of, it is certain that very good seedlings might be raised from it in abundance. This variety and several others are frequently raised from seed by the French. They select the stones from the finest ripe fruit, and stratify them till autumn. They are then planted in rich soil, covered 2 inches deep, and, in case of severe frost, a covering of leaves or of litter is afforded. The seedlings may be transplanted in the following autumn, and in doing so, the tap root should be shortened.

Budding is the general mode of propagating the apricot, and usually the Musclee and common plums are the stocks selected. In France, it is budded upon the Damas Noir, Cerisette, and Saint-Julien; and it may be well to observe that these stocks are recommended to be in all cases raised from the stones of these varieties, and not from suckers or layers, because the latter are comparatively weak, and apt to cause gumming. The Brussels and the Brompton stocks have also been employed, but, on the authority of Mr. George Lindley, the latter ought not to be used as a stock; on the Brussels stock, however, apricots may be budded for standards to cover the upper parts of high walls, as its shoots are tall and vigorous, and soon form the required height of stem. The apricot may be budded as early as the middle of June, but later than this is preferable, so long as the buds run freely, that is, whilst the bark with the bud can be easily detached from the alburnum. In selecting the buds, care should be taken not to insert blossom-buds instead of wood-buds.

Grafting is seldom employed, but it may be resorted to in certain cases, as where buds of any particular variety have failed. Success greatly depends on the proper selection of scions. These should consist of portions of the base of shoots having the buds very close to each other; or the lower portion of the scion may consist of two-years old wood, which should, however, be well thinned away in preparing the scion for whip-grafting, which in this, as in most cases, is the preferable mode. As active vegetation commences very early in the apricot, the scions should be cut off at a still earlier period. In mild weather, they may be cut off early in January, and laid in to half their length in moist, sandy soil, or in sand kept moderately moist, but not saturated; and they should be grafted as soon as the sap becomes active in the stocks. The grafts ought to be immediately afterwards earthed up as high as the top of the clay.

Soil and Situation.—The apricot will succeed in any good, free garden soil, or loam that is rather sandy than otherwise; strong clay soils do not suit it, neither does it thrive so well in strong loams as it does in those that are friable.

The ground ought to be well drained so that no water may stagnate in winter within 4 feet of the surface. If the soil is a fine, yellow loam, the roots will readily penetrate it in moist seasons, and the tree will grow rapidly; but when it has attained a considerable size, the great amount of evaporation which takes place by the foliage will soon dry the loam, and render the roots which are embedded in it almost useless. The leaves then become diseased for want of sap, mildew ensues, and the tree is ruined if means are not taken to avert the evil. But it is better to prevent it entirely by duly preparing the soil before the tree is planted. In all cases it should be trenched; and in so doing, if the soil, or part of it, is loamy and rather adhesive, it should be turned up to the top, where it can be rendered permeable to rain by mixing with such manures or composts as will render it open. Turf, which contains much fibre, is excellent for the purpose.

In the south of England, some kinds of apricots, such as the Breda and the Roman or Common, bear well as standards if the springs are favourable; and although the fruit of such is not so large as from trees on walls, yet it is more juicy and of richer flavour.

The trees may be planted, as standards, at from 20 to 25 feet apart. The apricot, however, is chiefly cultivated against walls. In the warmer parts of the country, east and west aspects are suitable; but aspects inclined to south-west or south-east are to be preferred; whilst in the northern parts of England, and in Scotland, a south aspect is generally necessary to give the fruit its full flavour. The distance between trees against walls should be about 20 feet. Planting may be performed in the end of September; for the buds on the lower part of the shoots are matured early in the season, and growth stops in August, or at least the elongation of the shoots is almost entirely arrested at that period of the season, for a week. The shoots then make a fresh start, and a marked difference may be observed between the portion of the shoot produced before and that after the stoppage. Now, the older leaves may be cut off from the lower part of the shoots when the tree is about to be taken up; a few left on the second growth will be sufficient to draw sap and maintain circulation till the transplanted tree make fresh roots; and having made these before winter, it will be ready to push in spring, and in the course of the season will be well established and in a condition to produce vigorous shoots for training as principal branches. Although the above period is mentioned as that which is proper on account of the tree making fresh roots before winter, for the production of which the heat of the ground is highly favourable, yet the operation should not be undertaken if the weather is dry. In that case, it is better to wait till it is moist. Planting may also be very successfully done any time in October, or during the first fortnight of November; but if later than this, fresh roots cannot be expected to be made before spring. It will doubtless frequently happen, that borders cannot be prepared so early in the autumn as the periods above recommended, in which case planting may be performed any time during mild weather in the months of December and January, but if possible not later than the middle of February; for, as already observed, the apricot vegetates early, and it is well known that trees do not grow so vigorously if transplanted after they have commenced to push, as they do when vegetation is in a comparatively dormant state.

Pruning and Training.—Fan-training is the best for the apricot tree, because the branches

are apt to die off; and, as explained in treating of the plum, vacancies can be most readily filled up by adopting that mode of training. Besides, the tree is one of those which do not admit of horizontal branches being taken from an upright stem, without the risk of such branches dying off. The fan method is, therefore, the most eligible. Commencing the training with a maiden plant consisting of one upright vigorous shoot, let the latter be cut down in autumn to 10 inches from the ground, and from the buds immediately below the section, let three shoots be encouraged, one to be trained upright, and one on each side for the lowest pair of branches. It is of the utmost importance to manage these three shoots so that the two side ones may be as strong as or even rather stronger than the upright one, which if left to themselves would not likely be the case. The central one should be checked in the beginning of June, by which time its wood will be firm as far up from the base as the place to which it will have to be cut back in autumn, at which time the two side shoots ought to be of equal thickness and vigour, and each of them fully stronger than the central one. With this in view, the trees should be frequently inspected during the growing season, and the experienced eye will, by a glance at each tree, determine whether the above conditions will be fulfilled. If the side branches are evidently not keeping pace with the central upright, means must be taken to check its progress, and the sooner such means are taken, the less will be the difficulty in effecting the object. The flow of sap is easily diverted in greater force to any shoot that is on an equality, or nearly so, with those towards which the flow is intended to be in a diminished ratio; but, when any shoot or shoots have been in the habit of drawing an undue share, and have established a connection with the roots, so as to have a continuation of an excessive supply, it is not an easy matter to divert the sap from such free channels into those parts where the channels are only adapted for a limited supply. It can only be effected by encouraging an increased breadth of foliage in the weak parts, and diminishing that connected with the strong. If a branch is slender, it will sooner or later become strong, according as it is the medium of communication between a large or small amount of foliage on the shoots, whether that amount is borne immediately by the branch,

or on lateral branches and shoots originating on it. Bearing in mind this fact, we may strengthen a weak branch by encouraging it to bear subsidiary branches. If, on the contrary, a branch is too strong, it may be made to grow but very slowly, by permitting it to bear only a limited number of side branches, if any. By these, and other means pointed out in the articles on pruning and training, a due proportion of strength can be insured among the branches of the apricot tree, and when this is the case, its management in other respects is not difficult.

The main branches ought to diverge equally; when they extend so as to be 15 inches apart, each branch should be subdivided into two; and when the branches resulting from this subdivision have extended so as to be again at the above distance apart, they should be again subdivided. In this way, the principal branches of the tree will be produced with regularity, and there will be space for laying in young wood for bearing.

The apricot, when it arrives at a bearing state, produces its fruit on the shoots of the preceding summer's growth, and also on spurs on wood that is two, three, or more years old. The finest fruit is, however, produced on the one and two years old wood, and therefore a proper supply of such ought to exist in all parts of the tree. Young shoots should be laid in between the principal branches, but rather thinly than otherwise, for it is an error to crowd the tree with more shoots than can well grow, when on half the number of shoots much more fruit would set than the tree could possibly bring to perfection. Young shoots should therefore be laid in at every 10 or 12 inches, and ought to be shortened to about 1 foot in length, a little longer if they are strong, and shorter if weak. If they should not bear in the following season, that is, when they are one year old, they may be allowed to remain another year, when they will rarely fail if the spring be favourable. The young shoot, after having been pruned in autumn, should be nailed in the course of the winter pretty close to the old branch, in order to afford room for a succession shoot, which should be encouraged in the following summer. If the shoot first laid in has borne fruit, and if at the autumn pruning the young shoot is seen to be furnished with blossom buds, the one that has borne should then be cut away; but if not, both ought to remain another

season, in which no succession one need be trained, the older shoot being already accompanied with a younger. In the autumn, the older of the two should be cut out and the younger trained in its place, and for this a succession shoot ought to be encouraged in the following summer. Thus, there will be single shoots, originating at about 10 or 12 inches apart, laid in between the principal branches. In the second summer, from the base of each of these shoots another should be trained. Or, instead of originating on the base of the shoot first laid in, a succession shoot may sometimes be eligibly obtained from the branch itself, and of such, advantage should be taken. When the shoot first laid in is in the second summer of its age, a young shoot to replace it will be growing. If considered advisable to retain both these for another summer, no young shoot for succession will require to be grown in that summer; but, if only one be retained, then a succession shoot must be encouraged. Besides the shoots to be managed as above, spurs will form along the branches. A moderate sprinkling of these should be permitted where the branches would otherwise be too naked. From these spurs, however, long shoots ought not to be allowed to grow. The young shoots should be pinched or cut back to two buds, when only a few inches long.

Disbudding is an operation which may be treated of in connection with summer pruning. It consists in removing shoots when they have pushed only as far that they can be laid hold of between the finger and thumb. The shoots which should be so removed are chiefly those in front of the branches, where they would otherwise form useless breast-wood. The operation should be first performed in the upper and more vigorous parts of the tree, and after a short interval another portion should be removed. The finger and thumb only ought to be used when the shoot is in a very young herbaceous state; but as soon as it becomes somewhat woody, the knife must be used, otherwise the bark is apt to be torn, and gumming is induced. Indeed, it would be better to use the knife in all cases, for the wounds made by it are more easily healed than those occasioned by pinching; and, by an expert hand, the operation may be performed with the knife almost as expeditiously as with the finger and thumb. The foreright shoots having been gradually removed, superfluous

shoots situated elsewhere should either be cut clean out, or shortened for spurs. If all the branches are maintained in a proper degree of vigour, none being allowed to become either too weak or too strong—and this will not be the case, if care be taken that the different branches are furnished with about an equal amount of foliage—the sap will be equally distributed, and, as a consequence, the tree will be healthy and fruitful, other circumstances being favourable.

Thinning the fruit should be done when it is very young, in which state the thinnings may be used for tarts. Large kinds should be allowed twice the space afforded to those which are only half their size. On vigorous branches, or on shoots that proceed from such, more should be left than on parts that are weak, for, where this can be done, it will prove advantageous in repressing excessive vigour.

Cultivation.—Before the mean temperature of the air in spring is, on the average, higher than that of spring or other water which may be employed, the soil and subsoil where the apricot tree is growing should be examined, and if dry, it should be sufficiently watered. The examination ought to be made about the beginning of March, at which time spring-water will in general be several degrees warmer than the air, and will therefore rather promote than check vegetation. At this season the surface soil is usually moist enough; but loamy subsoils, that have never been thoroughly trenched, and rendered porous by an admixture of suitable materials, are not readily moistened throughout, either by rain or mere surface watering. The surface soil should be ridged as deeply as can be done without interfering with the roots, and the ridges ought to run parallel to the wall. The hollows between the ridges should then be filled with water, and as it subsides the supply ought to be renewed, until the subsoil is thoroughly soaked. This may be sooner effected by making holes with a crowbar, so deep as to penetrate a little way into the loam; but only a little way, for if the crowbar were deeply inserted, the roots would some day follow its direction, and thus become more deeply embedded than would be desirable. After the object of this watering has been attained, and after the water has fairly subsided from the surface, the ridges may be levelled. The tree will then be in a condition

to make a healthy growth, which it could not have done if a thorough watering had not been given. If only the surface roots are supplied with moisture, whilst to those more deeply situated the supply is deficient, mildew is apt to attack the foliage; and although this most destructive disease may be subdued to a considerable extent by flowers of sulphur, yet the health of the trees cannot be restored whilst the cause of the disease is allowed to exist. We have known apricot trees which were nearly killed by mildew, notwithstanding the repeated application of sulphur and frequent syringing, cured in the following manner. Although covering the wall, they were taken up in autumn, and, after the border had been deeply trenched, and the loamy subsoil broken up, replanted. In the following season they produced healthy foliage, quite free from mildew, no application of sulphur being necessary. Where a border has not been properly prepared, and where the trees are severely attacked by mildew, it is advisable to take them up, if not too old, and replant them after the border has undergone due preparation; for although watering as we have recommended will be effectual in many cases, yet there may be others in which it would be difficult to insure the uniform moistening of all parts of the soil where the roots may travel, as when they pass under walks, &c. If watering be necessary in summer, rain-water is to be preferred to that from springs, for the latter, although in reality no colder than it was in spring, or probably even somewhat warmer, yet is relatively much colder than the mean temperature of the air in hot, dry weather in summer, and ought not to be applied unless previously warmed by exposure to the sun and air.

Protection.—The blossoms of the apricot are very liable to be cut off, owing to their appearing so early in the season. They will bear a slight frost, but often perish on being exposed to a continuous low temperature for several days, especially if it occur after the trees have been excited by previous warm weather. Wide coping-boards are good, and, in most cases, sufficient protection; but, besides these, woollen netting will be necessary in cold situations, and in nights of severe frost. The nets may also be usefully employed as a protection from too much heat, when the fruit is ripening. It has often been observed, that in hot, sunny weather the fruit of the apricot against a wall

is soft and ripe on the exposed side, and hard and green on the side next the wall. This is apt to be the case with the Moorpark and other large sorts. By partially shading from the sun's rays by netting, the exposed part of the fruit will not come forward so rapidly, and the shaded side will have time to become more mellow. If it do not become perfectly so when the other is on the point of being ripe, the fruit should be gathered and placed in a warm place, with the imperfectly ripened side towards the sun.

Diseases and Insects.—The apricot is subject to the same diseases, and is attacked, though to a less injurious extent, by the same insects, as the peach and nectarine. A small yellowish green caterpillar (that of *Ditula angustiorana*, Steph.) frequently does considerable injury by feeding upon the leaves, and forming itself a habitation by tying them together by their extremities, thus causing the foliage to curl up as growth proceeds. When full grown, it ties together some fragments of leaves and changes into a brown pupa, from which the perfect insect emerges in July, before which time the caterpillar should be sought for and destroyed.

In some of the varieties, and especially the Moorpark, whole limbs occasionally perish in summer without any apparent cause. By some this is supposed to result from sunstroke, whilst others ascribe it to the sap-vessels being injured by frost.

THE PEACH AND NECTARINE (*Amygdalus Persica*, L.—Icosandria Monogynia, L.; Drupaceæ D. C., Lind.)—The peach is generally considered to be of Persian origin, and is supposed to have been carried into Egypt during the reign of Cambyses, then into Greece, and, after a lapse of time, into Italy, where it only began to be known about seven years before the Christian era. The native country of the peach is, however, still a doubtful point, and, as such, we may pass it over. It is extensively grown, but with frequently a limited share of cultivation, between latitudes 30° and 40°, in Asia, Europe, and America. Under circumstances particularly favourable, it will succeed considerably beyond these limits, but its deciduous nature requiring a period of rest, it is not fitted for a tropical climate. On the other hand, beyond lat. 48° the ground is too cold for its roots, and it will not long continue to thrive unless budded on some hardier species; the tree, also, requires the shelter of a wall or other artificial means of protection. If the

summer is hot enough to ripen the wood, it will stand a severe winter uninjured; but this is not found to be the case with trees in the open ground, if the young shoots have been grown under too low a temperature. In localities where the mean temperature of February is 40°, and that of March 44°, the peach tree will be in full flower against a south wall in the last week in March; and if the mean temperature of April is 49°, that of May 55°, June 61°, July 64°, and August 63°, the season may be considered a favourable one. The general crop, in that case, will be ripe in the last week of August or first week in September, and the fruit will acquire a high degree of perfection. By artificial means, or in a naturally warmer climate, the above period of five months from the time of flowering to that of ripening may be reduced to four, but not advantageously to a shorter period, except in the case of very early varieties. From the above, it will be seen that the peach flowers at a comparatively cool period. The blossoms may be destroyed by too much heat, but not by cold, unless actually frozen; therefore no warmer coverings than are just sufficient to protect from frost are necessary.

The different varieties of the peach are very difficult to distinguish from the appearance of the fruit alone; hence there was much confusion among them before any good mode of classification was adopted. The task, however, will be rendered much easier by the following arrangement. It is founded on the fruit having either melting flesh which parts readily from the stone, or firm flesh clinging to the stone; the leaves being serrated, without glands, or having either globose or reniform glands at their base; and the flowers being either large or small. By these means twelve sections are formed. The glands are situated at the base of the blade of the leaf, or on the petiole. Occasionally the distinctions between globose and reniform glands are not very obvious; but it will be observed that the globose ones are somewhat pedicellate, and raised above the margin of the leaf; whilst the reniform or kidney-shaped are indented in the margin. The flowers distinguished as *large* or *small* in some cases nearly approach each other in respect to size; but the small flowers have the petals more of an oval shape than the large, and their colour is different. The large flowers are deeply coloured at the base, whilst their disk becomes pale or nearly white towards the

margin. The small flowers, on the contrary, have their petals more deeply coloured at the margin than they are in the middle.

CLASS I. — MELTING PEACHES.

Flesh parting from the stone.

Division 1.—*Leaves serrated*, GLANDLESS.

Subdivision 1.—Flowers large.	Subdivision 2.—Flowers small.
Madeleine de Courson.	Royal Charlotte.
Malta.	Royal George.
Noblesse.	

Division 2.—*Leaves crenate*, with GLOBOSE glands.

Subdivision 1.—Flowers large.	Subdivision 2.—Flowers small.
Acton Seat.	Bellegarde.
Barrington.	Late Admirable.
George the Fourth.	Walburton Admirable.
Grosse Mignonne.	
Mountaineer.	

Division 3.—*Leaves crenate*, with RENIFORM glands.

Subdivision 1.—Flowers large.	Subdivision 2.—Flowers small.
Pourprée Hâtive.	Chancellor.
Shanghai.	

CLASS II. — CLINGSTONE PEACHES.

Flesh firm, adhering to the stone.

The divisions and subdivisions in this class are the same as those in the preceding one; but the varieties of which it is composed are now scarcely considered worthy of cultivation in this country.

1. MADELEINE DE COURSON—syn. Red Magdalen of Miller, Madeleine Rouge, French Magdalen, Rouge Paysanne.—*Leaves* doubly serrated, glandless. *Flowers* large, pale blush. *Fruit* middle-sized or rather small, globular, flattened at the base. Skin bright red next the sun, pale greenish white on the shaded side. Flesh yellowish white, with very little red at the stone, melting, very juicy, sweet, and rich. Stone middle-sized, blunt.

It ripens in the end of August or beginning of September, and is a good bearer, but the tree is rather tender.

2. MALTA—syn. Belle de Paris, Italian, Malte de Normandie, Pêche de Malte.—*Leaves* doubly serrated, glandless. *Flowers* large. *Fruit* middle-sized, globular, depressed at the summit. Skin slightly downy, finely marbled with red next the sun, pale green on the shaded side. Flesh greenish yellow, very slightly tinged with red at the stone, from which it parts freely, melting, very juicy, vinous, and rich. Stone middle-sized, pointed, rather rugged.

It ripens in the end of August or beginning of September, keeps well after gathering, and bears carriage better than any other melter. It is a hardy and excellent sort.

3. NOBLESSE—syn. Lord Montague's Noblesse, Mellish's Favourite, Vanguard.—*Leaves* doubly serrated, glandless. *Flowers* large, bluish. *Fruit* large, globular, depressed on the summit when well grown, otherwise, it is sometimes rather pointed. Skin slightly downy, pale yellowish green on the shaded side; red, marbled with streaks and blotches of dull red on the side next the sun. Flesh white to the stone, from which it parts freely, melting, very juicy, rich, and excellent. Stone large, pointed, very rugged.

It ripens in the end of August or beginning of September.

4. ROYAL GEORGE—syn. Early Royal George, Griffin's Mignonne, Lockyer's Mignonne, Millet's Mignonne, Red Magdalen, Madeleine Rouge à Petites Fleurs, French Chancellor and Bourdine of some.—*Leaves* doubly serrated, glandless. *Flowers* small, dull red. *Fruit* large, globular. Skin very downy, deep red next the sun, pale greenish white dotted with red on the shaded side. Flesh pale yellow, rayed with red at the stone, from which it parts freely, very juicy, melting, rich, and vinous.

It ripens in the end of August or beginning of September. The tree is a good bearer and forces well, but is subject to mildew. The variety is deserving of extensive cultivation.

5. ROYAL CHARLOTTE—syn. Madeleine Rouge Tardive, Madeleine Rouge à Moyennes Fleurs, Madeleine à Petites Fleurs, Grimwood's Royal Charlotte, New Royal Charlotte, Kew Early Purple, Lord Fauconberg's, Lord Nelson's.—*Leaves* deeply, doubly, and coarsely serrated, glandless. *Flowers* small, but larger than those of the Royal George. *Fruit* large, roundish, deep red next the sun, clouded with streaks of darker red; pale yellow, slightly mottled on the shaded side. Flesh pale greenish yellow, rayed with red at the stone, from which it parts freely, juicy, melting, very rich and sugary. Stone rather larger and more rugged than that of the Royal George.

It ripens in the beginning of September. The variety is allied to the Royal George.

6. ACTON SCOT.—*Leaves* crenated, with globose glands. *Flowers* large. *Fruit* middle-sized, round. Skin slightly downy, deep red next the sun, marbled with crimson towards the shaded side, which is pale yellow or whitish. Flesh pale yellow, reddish at the stone, from which it parts freely, juicy, melting, sugary, and rich. Stone small.

It ripens in the end of August, and is an excellent early sort.

7. GROSSE MIGNONNE—syn. Mignonne, French Mignonne, Large French Mignonne, French Grosse Mignonne, Swiss Mignonne, Grimwood's Royal George, Grimwood's New Royal George, Vinense, Vineuse de Fromentin, Veloutée, Veloutée de Merlet, Pourprée de Normandie, Avant, Purple Avant, Early Purple Avant, Early May, Early French, Early Vineyard, Padley's Early Purple, Neil's Early Purple, Johnson's Early Purple, Johnson's Purple Avant, Forster's, Forster's Early, Ronalds's Early Galande, Belle Bausse, Belle Bause, Belle Beauté, Kensington, Royal Kensington, Royal Sovereign, Superb Royal, Transparent.—*Leaves* crenated, with globose glands. *Flowers* large, deep red. *Fruit* large, round, somewhat depressed, and hollowed at the summit. Skin slightly downy, pale yellow on the shaded side, mottled with red towards the sunny side, which is of a dark red colour. Flesh pale yellow, rayed with red at the stone, from which it parts freely, melting, juicy, very rich, and vinous. Stone small, slightly pointed.

It ripens in the end of August or beginning of September. The fruit does not bear carriage well. The tree is a good bearer, forces well, and is not so subject to mildew as the sorts with serrated leaves.

8. MOUNTAINEER.—*Leaves* crenated, with globose glands. *Flowers* large, bluish. *Fruit* large, nearly round, slightly pointed at the summit. Skin slightly downy, sometimes nearly smooth, pale yellow on the shaded side, dotted with red towards the sunny side, which is generally of a deep red. Flesh pale yellowish green, rayed with red at the stone, from which it parts freely, melting, juicy, and rich, with a flavour resembling that of the Belle-garde. Stone small.

It ripens in the beginning of September.

The variety was raised from the Red Nutmeg Peach, impregnated with the Violette Hâtive Nectarine.

9. BARRINGTON—syn. Buckingham Mignonne, Colonel Ansley's.—*Leaves* crenated, with globose glands. *Flowers* large, bright red. *Fruit* large, round, or somewhat elongated. Skin downy, deep red next the sun, pale yellowish green on the shaded side. Flesh whitish green, slightly rayed with red at the stone, from which it parts freely, very juicy, melting, rich, and of high flavour. Stone small, with a long sharp point, very rugged.

It ripens in the middle of September.

The tree is vigorous, and less subject to mildew than most others.

10. GEORGE THE FOURTH.—*Leaves* acutely crenated, with globose glands. *Flowers* small, dull red. *Fruit* middle-sized or large, globular, with a deep cavity at the footstalk. Skin moderately downy, of a fine pale yellow on the shaded side, and mottled with bright red towards the sunny side, which is of a uniform dark crimson. Flesh pale yellow, rayed with red at the stone, from which it parts freely, melting, sweet, and rich. Stone very small, blunt.

It ripens in the beginning of September, and forces extremely well.

11. BELLEGARDE—syn. Brentford Mignonne, Galande, French Royal George, Noire de Montreuil, Large Violet, Violette Hâtive of the English, Early Galande and Smooth-leaved Royal George of some.—*Leaves* crenated, with globose glands. *Flowers* small, reddish pink. *Fruit* large, globular. Skin dark red, streaked with dark purple or violet next the sun, pale green, slightly tinged with yellow on the shaded side. Flesh pale yellow, parting freely from the stone, at which it is slightly rayed with red, melting, juicy, rich, and excellent. Stone rather large.

It ripens in the beginning or middle of September, succeeding the Royal George and Grosse Mignonne; it also keeps longer after gathering than these sorts. The tree is very healthy, and not subject to mildew.

12. LATE ADMIRABLE—syn. Boudin, Bourdine, Bourdine, French Bourdine, Judd's Melting, Motteux's, Royal, La Royale; Belle Bausse, Belle Bauce, Pourprée Tardive, and Late Purple of some.—*Leaves* crenated, with globose glands. *Flowers* small, pale red. *Fruit* large, roundish, somewhat oblong, with a slight depression at the summit, in which there is commonly a small nipple. Skin very downy, dull crimson, with dark streaks next the sun, pale green on the shaded side, slightly mottled at the junction of the two colours. Flesh pale yellowish green, red at the stone, from which it parts freely, melting, and very juicy. Stone rather large, with a long sharp point.

It ripens in the middle or end of September; and is one of the best late peaches either for the open ground or forcing.

13. WALBURTON ADMIRABLE—syn. Walberton Admirable (Plate II.)—*Leaves* crenated, with globose glands. *Flowers* small.

Fruit large, round. Skin pale yellowish green on the shaded side, crimson next the sun, mottled and clouded with darker colour. Flesh yellowish white, melting, juicy, rich, and high-flavoured.

It ripens in the end of September or beginning of October. The tree is very hardy, and a good bearer. A most excellent variety.

14. POURPRÉE HÂTIVE—syn. Pourprée Hâtive à Grandes Fleurs, Early Avant and Avant Rouge of some.—*Leaves* crenated, with reniform glands. *Flowers* large. *Fruit* as large as the Grosse Mignonne, which it very much resembles in form, colour, and flavour, but it ripens a week or ten days earlier than that early sort, a very important consideration. The Pourprée Hâtive, probably from the similarity of the fruits, has been confused with the Grosse Mignonne; but the leaves of the one having reniform glands, and those of the other globose glands, there need be no such mistakes in future.

15. SHANGHAI.—*Leaves* crenated, with reniform glands. *Flowers* large, deep red. *Fruit* very large, roundish. Skin downy, pale yellowish green on the shaded side, of a delicate crimson next the sun. Flesh pale yellow, very deep red at the stone, to which it is partially attached by strong fibres, but not everywhere adherent, as in the Clingstone peaches, melting, juicy, and rich. Stone large, obovate.

It ripens in the middle of September; and the tree is a good bearer, but requires a warm season and a southern aspect to ripen its fruit properly. The fruit should be gathered a day or two before it is used.

16. CHANCELLOR—syn. Late Chancellor, Chancellière of Duhamel, Noisette, Steward's Late Galande, Edgar's Late Melting.—*Leaves* crenated, with reniform glands. *Flowers* small, reddish. *Fruit* large, roundish oval. Skin moderately downy, of a uniform dark crimson next the sun, pale greenish yellow on the shaded side, mottled with bright red at the junction of the colours. Flesh pale yellow, much rayed with deep red at the stone, from which it parts freely, melting, very juicy, rich, and vinous. Stone oblong, pointed at the summit, very red.

It ripens about the middle of September.

NECTARINES.

The mode of classification adopted for the varieties of the peach is applicable to those of the nectarine.

CLASS I.—MELTING NECTARINES.

Flesh parting from the stone.

Division 1.—*Leaves serrated*, GLANDLESS.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Division 2.—*Leaves crenate*, with GLOBOSE glands.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Pitmaston Orange.

Division 3.—*Leaves crenate*, with RENIFORM glands.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Stanwick.
White.Balgowan.
Downton.
Elruge.
Impératrice.
Violette Grosse.
Violette Hâtive.

CLASS II.—CLINGSTONE NECTARINES.

Flesh firm, adhering to the stone.

Division 1.—*Leaves serrated*, GLANDLESS.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Early Newington.

Division 2.—*Leaves crenated*, with GLOBOSE glands.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Division 3.—*Leaves crenate*, with RENIFORM glands.

Subdivision 1.—Flowers large. | Subdivision 2.—Flowers small.

Roman.

1. PITMASTON ORANGE—syn. Williams's Orange, Williams's Seedling (Plate II.)—*Leaves* crenated, with globose glands. *Flowers* large, bright red. *Fruit* large, globular or almost heart-shaped, terminating in a small point or nipple. Skin deep purple or violet, spotted with brown next the sun, orange on the shaded side, mottled with purple at the junction of the colours. Flesh rich yellow or orange, with short, bright red rays at the stone, from which it parts freely, melting, juicy, sweet, and of better flavour than the other sorts with yellow flesh. Stone large, sharp-pointed, very rugged.

It ripens in the end of August or beginning of September. The tree is hardy, and an abundant bearer.

2. STANWICK.—*Leaves* crenated, with reniform glands. *Flowers* large. *Fruit* large, roundish oval. Skin pale green, like that of the White Nectarine where shaded, with a clear violet blush next the sun. Flesh white, parting from the stone, tender, juicy, rich, and sugary. Stone middle-sized, ovate, very rugged, of a chocolate colour; kernel sweet, like a nut, with nothing of the bitter almond flavour.

It ripened in a peach-house a fortnight later than the Bellegarde, on which it was budded. It has, however, been found unsuited for cultivation on walls, unless protected, in the early part of the season, with glass.

The variety originated from a stone brought from Suedia, in Syria, by the late Mr. Barker, formerly Her Majesty's vice-consul at Aleppo, and which was given by him to the Duke of Northumberland, and raised at Stanwick Park.

3. WHITE—syn. Cowdray White, New White, Emmerton's New White, Large White, Neat's White, Flanders.—*Leaves* crenated, with reniform glands. *Flowers* large. *Fruit* large, roundish, depressed on the summit. Skin whitish or pale yellowish green, with a slight blush of red next the sun. Flesh greenish white, parting freely from the stone, very juicy, rich, and vinous. Stone middle-sized, rugged.

It ripens in the end of August or beginning of September.

4. ELRUGE—syn. Common Elruge, Claremont, Oatlands, Spring Grove.—*Leaves* crenated, with reniform glands. *Flowers* small, pale red. *Fruit* middle-sized, roundish, inclining to oval. Skin dark violet red next the sun, pale red towards the shaded side, which is whitish or pale green. Flesh whitish, tinged with red at the stone, from which it parts freely, melting, juicy, rich, perfumed, and delicious. Stone middle-sized, oval, deeply fissured, slightly pointed, light brown.

It ripens in the end of August or beginning of September. The tree is an abundant bearer, and forces well. One of the very best varieties.

5. VIOLETTE HÂTIVE—syn. Aromatic, Brinion, Early Brugnion, Brugnion Hâtif, Hampton Court, Lord Selsey's Elruge, Large Scarlet, New Scarlet, Violet, Early Violet, Violet Musk, Violette Musquée, Violette d'Angervillières.—*Leaves* crenated, with reniform glands. *Flowers* small, reddish. *Fruit* large, roundish. Skin dark purplish red, mottled with pale brown dots next the sun, pale yellowish green on the shaded side. Flesh whitish or pale yellowish green, much rayed with red to some distance from the stone, from which it parts freely, melting, juicy, very rich and excellent. Stone middle-sized, roundish obovate, with flattish rough ridges of a red colour.

It ripens in the end of August or beginning of September, and is one of the very best sorts either for the open ground or for forcing.

6. VIOLETTE GROSSE—syn. Grosse Violette Hâtive Violette, Le Gros Brugnion.—*Leaves* crenated, with reniform glands. *Flowers* small. *Fruit* like that of the Violette Hâtive, but

larger; the stone is likewise larger. The flesh, however, is scarcely so rich and fine.

It ripens in the beginning or middle of September, or somewhat later than the *Violette Hâtive*.

7. DOWNTON.—*Leaves* crenated, with reniform glands. *Flowers* small. *Fruit* much resembling the *Violette Hâtive*, but somewhat larger. Flesh melting, rich, and highly flavoured.

It ripens in the end of August or beginning of September. The tree is a good bearer and of a good constitution, more vigorous than the *Elruge*, between which and the *Violette Hâtive* it appears to have been raised.

8. IMPÉRATRICE (Plate II.)—*Leaves* crenated, with reniform glands. *Flowers* small. *Fruit* in form and colour resembling the *Violette Hâtive*. Flesh melting, rich, and aromatic, parting from the stone, at which it is rayed with red, but less so than the *Violette Hâtive*. Stone middle-sized, ovate.

It ripens in the beginning of September, and will hang and shrivel a little on the tree; it is then very rich. The tree is an excellent bearer, and appears to have a sound, vigorous constitution.

9. BALGOWAN.—*Leaves* crenated, with reniform glands. *Flowers* small. *Fruit* considerably larger than the *Violette Hâtive*, roundish oval, broadest at the base. Skin dark red next the sun, pale greenish yellow on the shaded side, mottled with dull red. Flesh pale yellowish green, rayed with red at the stone, from which it parts freely, rich, melting, and excellent. Stone large, oval.

It ripens in the beginning of September. The tree is remarkably vigorous, more so than perhaps that of any other variety of nectarine. On this account, as well as the large size of the fruit, it ought to be in every collection.

10. EARLY NEWINGTON—syn. Early Black Newington, New Early Newington, New Dark Newington, Black, Early Black, Lueombe's Black, Lueombe's Seedling.—*Leaves* doubly serrated, glandless. *Flowers* large, pale red. *Fruit* large, globular. Skin dark purplish red, marbled with pale brown, next the sun; pale green, slightly tinged with yellow, on the shaded side. Flesh yellowish white, purplish red at the stone, to which it firmly adheres, firm, juicy, and sweet when perfectly ripe. Stone rather large, roundish oval.

It ripens in the beginning of September.

11. ROMAN—syn. Old Roman, Red Roman, Brugnion Musqué, Brugnion Violet Musqué.—*Leaves* crenated, with reniform glands. *Flowers* large. *Fruit* large, roundish, dark red next the sun, bright red where less exposed, pale green next the wall. Flesh firm, pale yellow, adhering to the stone, from which it requires to be sliced, sweet, and tolerably rich when it begins to shrivel.

It ripens in the middle of September, and though handsome, yet, on account of its being a Clingstone, it is no longer highly esteemed.

Propagation.—The peach and nectarine are propagated by the stones, by budding, and sometimes by grafting.

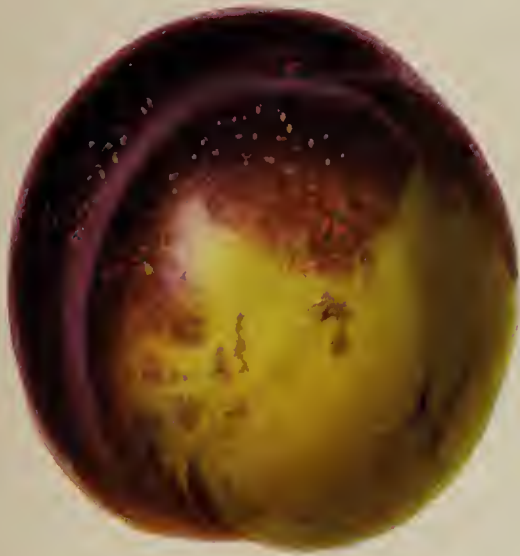
Propagation by the stone is the mode employed for new varieties, for continuing some of the old ones, occasionally with little variation, and for stocks. The method of raising plants from the stones has already been adverted to in the chapter on propagation. The plants will frequently be fit for budding in the same season, much depending on circumstances of soil and climate, whether natural or artificial, with which they may be favoured. Downing states that, in America, a stone planted in autumn will vegetate in the ensuing spring, and grow 3 or 4 feet high, and may be budded in August or September. The stones may also be placed in pots, vegetated and forwarded in gentle heat during the spring, and encouraged by shifting, till the weather becomes warm enough to admit of the plants being turned out in the open air. It is occasionally very convenient to have some young plants of seedling peaches for the purpose of budding with any scarce variety that might fail on the almond or plum stock.

Budding is the best and most generally adopted mode of propagating the peach and nectarine. It is necessary, however, in the first place, to know the best kinds of stocks.

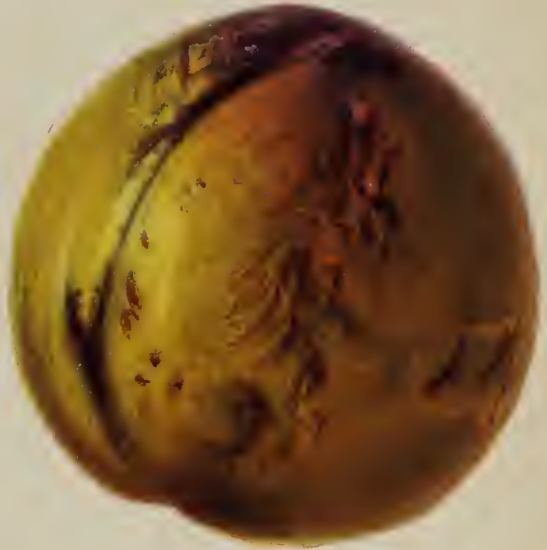
The peach stock is, of course, the most natural, but experience has proved that, in the soil of countries much farther to the north than that of its native country, the tree does not long succeed on its own roots. "At all events, the leaves, after several years, acquire partial tinges of yellow; and this goes on every year increasing, whilst the leaves are annually produced narrower and narrower, till at last the tree becomes useless. Peach trees received by the society from America were generally on the peach stock, and all those that were so invariably became affected in

NECTARINES AND PEACH

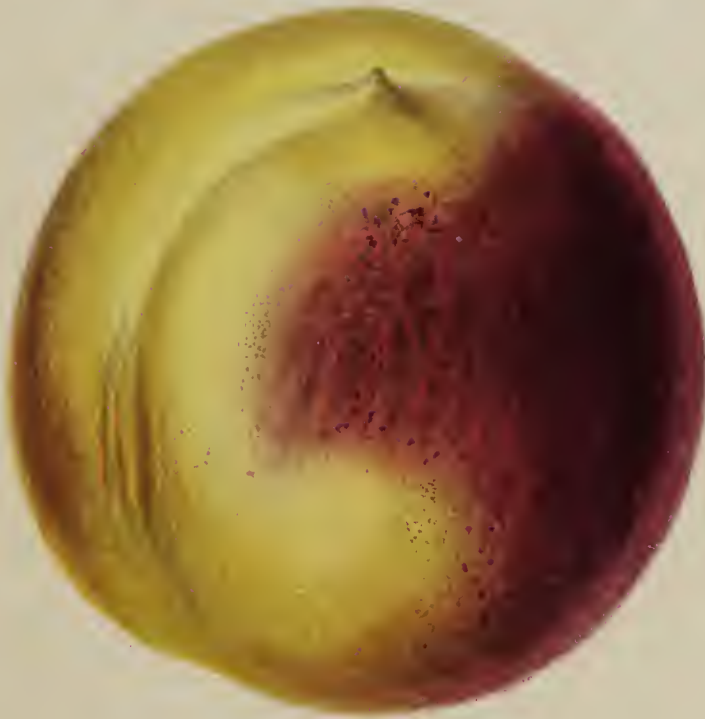
1



2



3



Drawn by Miss Williams

Eng^d by Thos Dick

1 *Imperatrice Nectarine*, 2 *Pitmaston Orange Nectarine*,
3 *Walburton Admirable Peach*.

the same way. George the Fourth peach was one of the best of them. In a series of seasons it extended 35 feet along the wall, but being on the peach stock, its foliage became so narrow and yellow, that it was found necessary to remove the tree. The same variety has now a healthy green foliage on the plum stock. This disease is doubtless the same as that so prevalent in America, where it is termed the *yellow*s. It is described by the late Mr. Downing, who perished, so much regretted, in consequence of the burning of the *Henry Clay* steamer; but his writings cannot fail still to produce a beneficial influence on American horticulture. In his *Fruits and Fruit-trees of America*, it is stated 'that this most serious malady (the *yellow*s) seems to belong exclusively to this country, and to attack only the peach tree. Although it has been the greatest enemy of the peach planter for the last thirty years, rendering the life of the tree uncertain, and frequently spreading over and destroying the orchards of whole districts, still, little is known of its nature, and nothing with certainty of its cause. Many slight observers have confounded it with the effects of the peach-borer, but all persons who have carefully examined it, know that the two are totally distinct. Trees may frequently be attacked by both the *yellow*s and the borer, but hundreds die of the *yellow*s, when the most minute inspection of the roots and branches can discover no insect or visible cause.' The same author observes that healthy peach stocks afford the most natural foundation for the growth of orchard trees. We admit that it is the most natural; but when we find that whole orchards, some containing from 10,000 to 20,000 trees, become diseased in America, and when in England, all on this stock, and on no other, are similarly affected under ordinary circumstances, we must conclude that the soil in both countries is uncongenial to the peach roots. They are soft, spongy, yellow—more like a pale carrot than the roots of trees we usually see. Most probably the soil is too cold for them. This probability is strengthened by the following instance. It was stated that all trees on the peach stock, under ordinary circumstances, were sooner or later affected. One of the Shanghai trees in the Society's garden has foliage not tinged with yellow as that of the others are, although it is, like them, worked on the peach, and is of the same age, planted at the same time in

similar soil, and sharing with the others the same aspect. But its luxuriant foliage exhibits a healthy dark green colour. Nearly opposite to where it is planted there is the fire-place of a room adjoining the fruit-room; the lower part of the wall is there heated through to the south side, so that there the latter often exhibits a dry surface when elsewhere it is wet; and the ground adjoining has been seen thawed when all not near this heated portion of wall was frozen; it is therefore evident that the roots of this particular tree must have been in a warmer medium than those of its fellows, and to this different circumstance, all others being the same, the difference as regards being free from disease may be fairly attributed.

"These remarks may be the means of preventing the planting of peach trees worked on the peach stock, and consequently the loss of the trees when they ought to be at their best. Excepting in parts of the world where the soil is never too cold, the peach stock ought not to be used. It is not the loss of only one plantation that has to be considered, for in such countries, as some parts of America, the trees rush up with little pains being taken, and they quickly bear sufficiently to repay that little; but presently disease makes its appearance, and the whole has to be cut down. The ground having been once cropped with stone fruit, will not bear such again without great expense in trenching, compared with which, that of procuring suitable stocks in the first instance would be inconsiderable."—(R. Thompson in *Journal of the Horticultural Society*, vol. vii. p. 231.)

From these facts it is evident that, although the peach takes well and grows vigorously on the peach stock, yet it soon becomes diseased, and therefore that stock should only be employed in a temporary manner and in cases of emergency.

The stock next in order, as regards natural adaptation for the peach, is the almond, which is also of the same genus. Of this, as a stock, the French have had long experience, and the sort they prefer is the hard-shelled sweet almond (*Amandier doux à coque dure*). All the varieties of the peach take readily on the almond; and it also succeeds well upon it in soils that are not cold and damp. Some varieties that do not take well on the kinds of plum stock usually employed, had better be worked on the almond for cultivation in the

southern parts of the kingdom, whenever proper fruit-tree borders have been formed.

Plum stocks are those generally employed in this country for peaches and nectarines. Hardy and almost wild varieties, called the Muscle from the form of the fruit, and the White Pear plum, are those most in use for this purpose in the nurseries. It is found that all varieties do not succeed equally well on both these stocks. The Muscle is the strongest grower, and is the best for those kinds that take well on it. The White Pear plum is employed for those which nursery-men term French peaches, but this is a distinction not very definite. Although many of the finer kinds of peaches take more readily on this stock than on any other, yet it has afterwards the disadvantage of not increasing in thickness in a corresponding degree with the peach worked upon it. We have seen the peach stem twice the thickness of the stock of this sort on which it was growing. The obstruction in the flow of sap which this disparity occasions, tends to throw the tree into a bearing state, but weakness soon ensues, and the trees die off sooner than on stocks which afford a freer circulation of the sap. The French employ the varieties called the Saint-Julien, the Damas Noir, and Myrobolan. M. Lepère, of Montreuil, states, that the preference is to be given to the Damas Noir, or Black Damask, which the cultivators near Paris get from Foutenay-aux-Roses; that they are cut down nearly to the level of the ground on planting, which is best done in November, and that they are budded when they have made fresh shoots fit for being worked at the proper season. We have seen trees worked upon the Saint-Julien growing so perfectly in accordance with the stock, that, even after a number of years, scarcely any inequality could be detected at their junction. It is stated (*Gardeners' Chronicle*, 1853, p. 694) that peaches and nectarines succeed well when budded on the White Magnum Bonum plum. The writer recommends the Brussels to be worked near the ground, when young, with the White Magnum Bonum, and with this he asserts no peach or nectarine will ever refuse to identify itself.

The proper time for budding depends on the state of the weather. The stocks ought to be in condition to *run*, as propagators term it, that is, the inner bark should readily separate from the alburnum; and the buds must rise freely

from the shoot, which will generally be the case in July. Care should be taken that only wood-buds are employed, for if a fruit-bud is inserted instead, certain failure will be the result. When it is desirable to bud any particular sort, and if, from some unavoidable cause, the operation has been delayed till the stocks are *set*, that is, have the inner bark adhering so firmly to the alburnum that the bud will not rise without tearing, it is best to insert the bud with a thin slice of the wood, taking care, however, that it is pared flat, so that the inner bark may, when tied, be in contact with the cambium of the stock.

The peach and nectarine may also be grafted, if care is taken to select for scions shoots with firm, short-jointed wood, and with about 1 inch of two-year old wood at the lower end. Such should be taken off early in spring, and kept with their ends in moist sand till the grafting season arrives, that is, as soon as the sap of tree or stock begins to move. When worked, the successful taking of the grafts is greatly promoted by earthing up as high as the top of the clay.

Mr. Cameron practised, when at Highbeach, Essex, the following mode of grafting. He says, "Sow in autumn kernels of peaches, nectarines, or apricots, under the walls where they are to remain. They will make a vigorous shoot the following spring, and may either be budded in the August of the same year, or grafted the March of the year following. Grafting is the mode I prefer, and the scion should have $\frac{1}{4}$ inch of two-year old wood at its lower extremity; at least, I have found scions so taken off succeed better than those taken indifferently from any part of the young wood. Cut the stock with a dovetail notch for the scion to rest on, and tie it on in the usual manner. Remove the buds of the scion in back and front, leaving two on each side and a leader; when these have grown 6 or 8 inches, pinch off their extremities with the finger and thumb, by which means each shoot will throw out two others, and thus produce in autumn a fan-shaped tree with ten branches. I have generally found them bear two or three fruit the second year from the graft, and a proportionably greater number the third year." — (*Gardener's Magazine*, vol. iii. p. 149.)

Instead of sowing the stones of peaches or nectarines, we should much prefer those of the almond; for although the peach will take well on the peach stock and grow vigorously, yet

it will not continue to do so many years. We should also employ whip-grafting, taking care that the inner barks of stock and scion do not overlap each other at the lower end, for if they do, a projection apt to gum will be formed.

Soil and Situation.—In the climate of Britain, the peach requires a wall. In the southern parts of the kingdom it will succeed on an east or west aspect, if the locality is not too elevated and exposed to cold winds, nor, on the other hand, too low and subject to damp and fogs, in consequence of which the wood does not become perfectly ripened. But the most favourable situation is a wall with a southern aspect. As the peach requires to be trained against a wall, it follows that its roots must occupy a border in front. If this is made as recommended in the chapters on the formation of the fruit and kitchen garden, it will be fit for the reception of the peach. In old gardens, or others in which the borders have been formed, some improvements ought to be made before young trees are planted. It will therefore be necessary to point out, first, the soils, subsoils, and other circumstances which are unfavourable to the growth of the tree, in order that they may be avoided or remedied.

The subsoil should be first examined as to its condition with regard to moisture. If it is too wet, the trees will not thrive so long as their roots are in a saturated medium, especially whilst this remains in a cold state, neither will the fruit, under such circumstances, progress favourably. If, however, after midsummer, the moisture should become warm, the trees will not unlikely grow rapidly, but so late in the season that the shoots will be imperfectly ripened; therefore draining must be effected, if possible, in order to carry off all moisture that would otherwise be stagnant. If this is impossible for want of fall or outlet, then the level above which drainage may be carried out should be ascertained, and a moderate depth of soil raised above that level; for it is better to raise the border at the expense of losing say 1 foot of height of wall, than to plunge the roots to that depth in a medium which will prove injurious. In the one case, they would absorb nourishment conducive to the health of the whole tree, by encroaching only on the height of the wall to the extent of space for a pair of lower branches; in the other, being situated in stagnant moisture, they would draw watery, vitiated nourishment, and supply it to the whole tree. It is

therefore better that two branches be entirely dispensed with, in order to have the rest well fed, than that all should be improperly nourished, and consequently the whole produce deteriorated.

Having adverted to subsoils that are too wet for the peach, and the most obvious remedy, it will now be necessary to direct attention to those which are too dry. Where the soil is naturally shallow and resting on a subsoil that is dry and gravelly, it often happens that the tree suffers much from want of moisture in dry weather. Exposed to the accumulated heat of the sun's rays, often above 100°, the leaves evaporate an astonishing amount of moisture as long as the roots can supply it. Whilst any moisture is to be found within their reach, they will rapidly absorb it; but when all is exhausted their action must cease, and the condition of the tree must undergo a change for the worse, for it cannot be supposed that the foliage that was in a healthy state whilst evaporation was fully supplied, can continue in the same state when that supply is almost entirely stopped. Although the supply of moisture from the roots may have ceased, evaporation will still continue, drawing, to a considerable extent, from the juices of the tree; then it is that the red spider commences its most determined attacks, and which, if not arrested, would almost ruin the tree in one season. In order to conquer these small enemies, much labour must be employed, large quantities of water must be wheeled about, the engine must be kept at work, and, after all, the trees will not be so healthy as those that in properly made borders do not require one quarter of such labour to be expended upon them. In many cases, one year's expenditure in watering and syringing, if laid out in preparing the border before planting, would effect an annual saving of nearly an equal amount. As much should therefore be done in the first instance towards remedying the natural defects of the border as circumstances will permit. The dry gravelly subsoil ought to be dug out to the depth of $2\frac{1}{2}$ or 3 feet, or as near to these depths as it may be possible to obtain good soil to replace that removed. Although the bottom may be dry, yet, with a good depth of soil, the trees will not suffer readily from drought. When soil of the depth of $2\frac{1}{2}$ or 3 feet is well moistened, either by rain or watering, it takes a considerable time before the trees can suffer from drought.

With regard to the quality of the soil, if the ground is old and worn out, or if trees have long been grown in it, it is not proper for the peach. If it cannot be changed, it should be refreshed with other soil. If there is a stratum of loam below, let a considerable portion of it be brought up to the surface, and as much of the top soil turned down to the bottom, there to be dug over, mixing it at the same time with a portion of the loam. When black, worn-out soil is turned down in the bottom of trenches with previously undisturbed yellow loam above it, trees grow vigorously as soon as the roots get down to the black soil, although in this, when it was at top, they did not thrive, doubtless in consequence of the small amount of inorganic matter which such soil contains.

If the soil is poor and sandy, the trees will not find nourishment to enable them to support a good crop. A compost of dung and loam is better for the peach than dung alone, being more lasting, and not so apt to cause the trees to gum. Although poor sandy soil is not to be approved of, yet, as it can afterwards be enriched by suitable composts, it is preferable to soil that, on the contrary, is too adhesive. Stiff clays are most unfavourable, and the most difficult of any to deal with; in fact, the peach ought not to be planted in such. The best plan is to remove the whole, and replace with soil of a more friable nature, if possible. This may prove too expensive an operation for some persons to perform at once, but as much as 4 or 6 feet square might be cleared out where the tree is to be planted, and afterwards an additional portion could possibly be removed in advance of the roots, and exchanged for soil from an open part of the garden, where the stiff soil can be subjected to processes for amelioration which it could not be conveniently made to undergo in a border, and which will render it suitable for some kitchen garden crops. At Montreuil, where the culture of the peach is extensively carried on, the soil is by no means rich; it appears to be a calcareous sandy loam, of a yellowish brown colour, and seems to be too poor for corn crops. In the grounds of M. Lepère, one of the most skilful cultivators, the borders are prepared, to the distance of 5 or 6 feet from the wall, by trenching 2 feet deep, and mixing well the soil with manure. Afterwards, when the trees come to bear heavy crops, a little manure is forked into the border.

The success of the Montreuil cultivators, no doubt, depends on their mode of pruning, and other means which they adopt with the view of promoting an equal distribution of the sap. We think that 6 feet is too little for the width of the border. Although there is proof that a border of the above width will answer, yet a greater width will, in most cases, answer better. We know that peaches may be grown in pots, and, with the advantage of rich soil, a dozen of fruits may be grown to fair size, but a well-grown tree against a wall may bear as many as forty dozens, and to obtain nourishment to support such a quantity, the roots must have a considerable scope. As space on a south border is required for various early crops, the breadth may be 12, 15, or 18 feet, according to the size of the garden. Where an artificial border has to be made, its width is often necessarily limited to correspond with a certain amount of outlay. In that case, the made portion of the border should not be less than 6 feet, but 8 feet at least would be desirable. From what has been stated, it will be understood that, in preparing a border for peach trees, the extremes of wetness and dryness must be avoided, or remedied by such means as have been pointed out. As to the quality of the ground, any good fresh soil will answer, provided the trees are well managed. Where no expense is to be spared in order that an excellent border may be formed, good turfy loam should form the principal constituent, and if the loam can be made into a sort of compost, by mixing it with a little cow-dung and horse-dung, so much the better. A little bone-dust and lime may also be incorporated. In such a compost, the tree will grow quite as vigorously as it ought to do in our climate.

Planting.—The border having been prepared, the next consideration is the distance apart at which the trees should be planted. In good soil and a warm situation, this may be 20 feet; where the soil is not very rich—which, indeed, it ought not to be, or where the climate is rather cold—the distance may be somewhat less, say 18 feet, and it may be 15 feet; but less than this must be considered too limited for fan-training.

The best season for planting is the autumn, for the vegetation of the peach takes place early in spring, and when the plant is then removed, it receives a check which is injurious to it. When a young stem is cut back after the sap

is in full flow and the buds expanding into leaf, the portion of stem left has, in consequence, its internal structure much deranged; and although it may keep alive and be covered with young layers, yet, if the stem were cut over many years afterwards, all the portion of wood formed previously to the heading back will appear discoloured. On the contrary, a young stem cut back when the sap is comparatively at rest, or before winter, may die back a little way immediately below the section, but elsewhere it will exhibit little appearance of derangement in its vegetation. If it should happen that the planting cannot be done before vegetation commences in spring, the plants should be headed back in autumn, and taken up and planted as early in spring as circumstances will permit; or, if it is foreseen that the planting cannot, from unfavourable causes, be accomplished till late, the plants should be taken up early in February, and their roots put in the ground in a cool, shaded place, till the final planting can be performed. When the plants are cut back before they are taken up, they should not be cut quite so low as they would require to be when planted against the wall, in order to leave a choice of well-situated buds, to which they can then be cut.

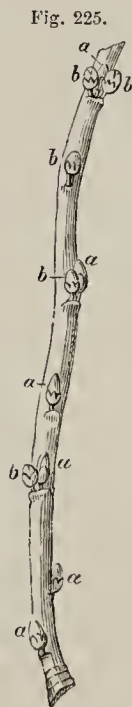
The trees should be planted as deeply in the soil as they were before removal, and about 6 inches from the wall. Some recommend the tree to be planted with the budded part outward, but this is immaterial; indeed, if there is any wound, it will heal sooner on the south side than on the opposite one, especially if shaded from the sun's rays, because on the former thicker layers of wood are deposited. The mode of planting detailed in the case of the plum, &c., is also applicable to the peach. When planted it is well to mulch as far as the roots extend with stable litter.

Mode of Bearing.—As all the parts of a tree, except the root, proceed from a single bud, it will be necessary, for the sake of precision, to distinguish the progressive stages of the growth of those parts. The bud produces a shoot on which, during the summer, leaves and buds are developed. From the time that this shoot pushes in spring till its leaves drop in autumn, we propose to designate it as a *young shoot*, corresponding with what the French term *bourgeon*. From the time that the young shoot ceases to elongate for the season, becomes mature, and drops its leaves in autumn, until it begins to push young shoots

in spring, we shall call it a *shoot*. In this state it is termed a *rameau* by the French. After the shoot begins to push buds and form young shoots, it may be called a *young stem*, if occupying the position of a stem; if otherwise, a *young branch*. This the French call a *branche*. After the young branch has matured shoots, or when it is two years old, it may be termed a *branch*.

As the young shoot proceeds in growth, leaves are produced at every node or joint, singly, in twos, or in threes; and in the axils of each leaf, either fruit-buds or wood-buds are formed. In the following spring the blossoms open before the wood-buds expand; and in the course of the season the fruit is brought to maturity. The fruit is also occasionally borne on short shoots somewhat resembling spurs, which are terminated by a cluster of blossom-buds, with a wood-bud or growing point in the middle, and which, instead of growing, remains almost stationary. Spurs of this sort are, however, of rare occurrence in trees that are managed so as to be properly furnished with successional bearing shoots. For bearing the crop, we ought to depend on these shoots, and not on spurs; therefore the latter need not be further noticed here.

It is necessary to be able to readily distinguish wood-buds from fruit-buds; for if, in pruning, a shoot is cut back to a fruit bud, no young shoot can proceed from it, and it will ultimately die back to the nearest wood-bud below the section.



Peach—Wood and Fruit-buds.

Wood-buds *a a*, Figs. 225 and 226, are of a conical, pointed form, and consist of scales surrounding a growing point, which, under favourable circumstances, pushes and becomes a shoot; but many of them remain dormant, especially if the shoot is weak and left at full length. When, however, the shoot is shortened to a wood-bud, that bud, stimulated by the sap that would otherwise flow towards the extremity, is almost sure to push.

Fruit-buds *b b*, Figs. 225 and 226, consist of scales, which inclose, not a growing point, but the rudiments of petals, stamens, and

pistil. They are ovate, and gradually become globose, assuming then a hoary appearance, from the scales opening and exposing their downy integuments. They are likewise much more plump than the wood-buds.

It will be observed, on referring to the accompanying figures, that some buds are single wood-buds, others are single fruit-buds; frequently the buds are double—one being a fruit-bud, the other a wood-bud, or both may be fruit-buds; and, lastly, some are triple buds. These generally consist of two fruit-buds with a wood-bud between them. As there must be wood before there can be fruit, it is natural for a young tree to produce chiefly wood-buds; but when the tree has attained a considerable size, it is more disposed to produce fruit-buds, and pruning becomes necessary, in order that fruit-buds may not too much predominate, for in that case a deficiency of young shoots would be the consequence.

Pruning and Training.—The peach tree requires what are termed winter pruning and summer pruning. The best time for performing the winter pruning is as soon as the leaves have fallen; that being the case, it would be more properly called autumn than winter pruning. However, it may be done in the latter season, or, indeed, at any time between the fall of the leaf and the rising of the sap, provided there is not severe frost. Summer pruning should be commenced as soon as the shoots begin to push, and is continued as may be found necessary during the growing season. Training may be done any time after the trees are pruned in autumn or winter, and before they get into active vegetation in spring. Summer-training the young shoots ought to be carried on when necessary throughout the growing season.

The peach tree is trained in a variety of ways, but the fan method is the best; yet it requires particular care and some knowledge of the physiology of the tree, otherwise the latter will become weak at bottom and too strong at top, as well as exhibit irregular growth throughout.

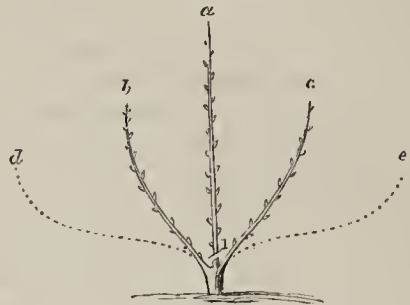
Fig. 226.



Peach—Wood and Fruit-buds.

Commencing with a maiden plant, consisting of a simple shoot from the bud, as at *a*, Fig. 227; let that be cut back, as at 1, above two eligible buds, situated one on each side, and about 9 inches from the surface of the ground. Two shoots will likely push from

Fig. 227.

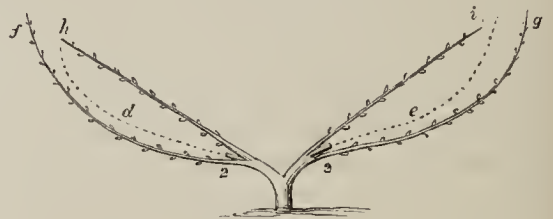


Peach Training.

these buds in the course of the summer; and they should be encouraged to grow as much as possible during the early part of the season, by training them rather upright, as in the direction *b c*; but in August they should be lowered by degrees to the position *d e*. They are thus brought nearly to a horizontal position, with the exceptions of their extremities, which are turned upwards, in order still to encourage growth; and, so long as they continue to grow, it matters not whether they are straight or otherwise, for they will be cut off at the winter pruning.

The dotted lines, Fig. 228, corresponding

Fig. 228.



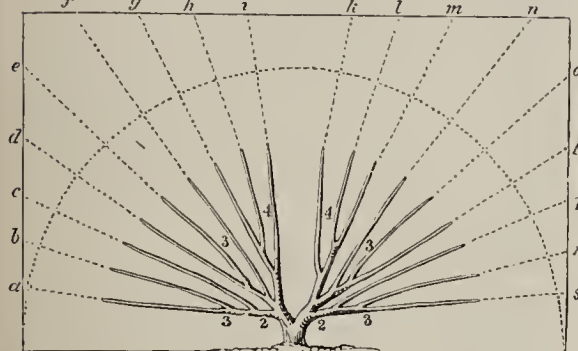
Peach Training.

with those in Fig. 227, represent the state of the tree, as regards its shoots, at the end of the first summer's growth, reckoning from the time when the maiden plant was headed back. At the ensuing winter pruning, the shoots *d, e* are cut back, as at 2, Fig. 228, and in the course of the summer four shoots *f, g, h, i* are the result. Here it should be observed that the extremities of the two lower branches *f, g* are turned upwards during the growing season; whilst the two upper ones *h, i* are not so favoured, otherwise, from being situated on the upper side, they would grow much stronger

than the two lower branches, an occurrence which should be carefully guarded against.

We have now seen that by the first cutting of the plant it is divided into two branches; and that by the second cutting, performed twelve months afterwards, it is divided into four. At the third cutting, which takes place after the second summer's growth, each of the four shoots is shortened, as at 3, 3, 3, 3, Fig. 229. Two shoots, proceeding from buds immediately below each of these cuts, give rise to shoots forming the origin of branches proceeding in the direction of *ab, de, op, rs*.

Fig. 229.



Peach Training.

When these have made one year's growth, shoots should be allowed to grow from below the bases of *a, b, &c.*, so as to originate the branches proceeding in the directions *c, f, n, q*. The branches from *a* to *f*, and from *n* to *s*, constituting the right and left wings of the tree, are now originated. These twelve branches spring from the bases of the shoots *f, g, h, i*, Fig. 228.

The two wings being well established, branches, to occupy the central portion from *g* to *m*, Fig. 229, must be originated. For this purpose, two shoots should be allowed to spring from near the bases of the two original subdivisions of the tree, as represented in the figure. These should be respectively subdivided at 4, 4, so as to give rise to the branches *g, h, l, m*. Then, two buds ought to be allowed to push from near the base, in order to form the branches *i* and *h*, which complete the number of the leading branches of the tree. Now, it will be observed that, with the exception of the stem itself, the bases of the branches from *a* to *f*, and from *n* to *s*, are the oldest parts of the tree, above ground at least. Of these branches, *ab, de, op, rs* are the oldest; *cf, nq* not being allowed to commence forming till a year after the others. The branches *a, b, c*, for

example, have the same common origin, all proceeding from the base of the shoot *f*, Fig. 228. If they were all allowed to originate at the same time, the upper one *c* would take the lead of the two below it. It is therefore better that they should be established a year before a competitor that would occupy a more advantageous position is permitted to exist. Of the next three branches, namely, *d, e, f*, which take their rise from the base of the branch *f*, the uppermost is originated a year after the two below; and such is also the case with similar branches on the other side of the tree.

The main point to be attended to in training the peach, is the maintenance of an equality of vigour amongst all the branches. The greater the vigilance used in preventing any material derangement of the equilibrium, the greater will be the ease with which it can be maintained. The branches should be frequently examined in detail; a comparative inspection ought to be made of every three, of the lowest three with the next three, and so on; and, again, every three on the one side with the three opposite on the other side. If one side of the tree is found to be weaker than the other, the branches of the weaker side should, in general, be elevated above their assigned position, and, on the contrary, three of the stronger side should be depressed. The latter ought also to be disbudded, and their summer shoots nailed in before those on the weaker side of the tree; and over-vigorous shoots should be checked at an early stage of their growth. All superfluous shoots ought to be dispensed with. Whilst a sufficient supply of shoots for succession must be encouraged, none beyond these should be allowed to exist, with the exception of those necessary for leaders. If, in the early part of the season, it is seen that a succession shoot will unquestionably become too strong, it should be stopped at an early stage of its growth. A number of other succession shoots may be allowed to grow to the length of 10 inches or 1 foot, and then be stopped. Several summer laterals will result; but they will push mostly just below where the shoot was stopped; whilst, lower down, enough of fruit-buds will in most instances be formed. By these means, the amount of foliage will be much less than would otherwise be the case. With regard to the weak side, an opposite mode of proceeding should be adopted. Shoots not absolutely

required for succession may very properly be allowed to grow. The succession shoots generally should be trained at full length; and, where there is space, the shoots at the extremities of the bearing shoots may also be left unshortened. If, on the weak side, a few over-strong shoots should start up, they had better be checked; but all others on that side ought to be encouraged. If we were to count the leaves on one side of the tree, and if they were found equal in number to those on the other, then the amount of vigour would also be equal, provided the leaves on both sides were of the same average size and equally healthy. This is a fact which should be borne in mind, but, in stating it, we do not mean to imply that the leaves should be counted, or their dimensions calculated. In practice, a sufficiently correct estimate of the relative amount of foliage on both sides can be formed by looking at the foliage on branch *a*, Fig. 229, then at that on the opposite branch *s*, and so on. Presuming that *a, b, c* and *d, e, f* are, according to their respective lengths, equally furnished with leaves, then the quantity of foliage borne by the first three, as compared with the three above them, will be nearly as 7 to 9; that being about the proportion which the united length of *a, b, c* bears to that of *d, e, f*. In that proportion, therefore, the increase of the base of the branches *d, e* will exceed that of the base of *a, b, c*; and the consequence will be that the former must every year become so much stronger than the latter, instead of which, it would be desirable that they should be of equal vigour and thickness. This condition would be obviated by not allowing the branches to extend beyond the semicircle *a, s*, but then, on referring to the figure, it will be seen that a large portion of wall is left uncovered. Supposing the trees to be planted 20 feet apart, and the wall to be 12 feet high, the space which a tree like that represented in the figure might occupy, would be 240 square feet; but if limited within the semicircle, it would only cover 166 square feet, leaving 74 square feet, or nearly one-third of the space, unoccupied. Rather than this should be the case, it would be almost better to put up with the loss of the three lower branches on each side. But, in order to guard against this, something may be done; allowing the radius of the semicircle to be 10 feet, then the distance between the branches where they intersect the dotted arc line—that is to say, when

they have extended 10 feet from the centre—will be very nearly 21 inches, which would be wider than necessary. To fill that space, branches may be originated from the upper side of *a, b, c*, at about 5 feet from the stem. There will then be six branches in connection with the base *a, b, c*, and they may be distributed over the space of wall from *a* to *d*, the latter being trained closer to *e*, so that between these two an intermediate branch may not be required; then, if *e* and *f* be subdivided, there will only be five branches in connection with the base *d, e, f*, instead of six, as in the case of the base *a, b, c*. This will give the latter considerable advantage; and, with the other means already detailed, an equality of vigour as regards the first two subdivisions of the tree may be maintained, whilst the symmetry of the whole is also preserved. What has been said of the branches on the one side of the tree applies, of course, to the corresponding ones on the other side.

With regard to the direction of the branches, it may be as well to point out how they may be laid off so as to present a regular appearance, without being too crowded in some places and too thin in others, as well as to prevent loss of time in rectifying errors which may easily be avoided in the beginning.

The system which has been detailed gives two principal branches, from near the base of each of which three branches are originated, and these are each subdivided into three; so that the leading branches of the tree consists of nine branches on each side, or eighteen in all. They form angles of about $9\frac{1}{2}^\circ$ with each other. Now, if they were laid off at this angle, like the radii of a semicircle, there would be nine branches on each side and one perpendicular in the centre—a position which, in fan-training, no principal branch should occupy, as it is then apt to grow too strong. It is, therefore, better to be without it, as in Fig. 229, in which two spaces are left between *i* and *k*; then eight more branches bring us down to *a*, which is elevated 5° above the line passing horizontally through the central point, and this elevation is an advantage to the lower branches.

From the principal branches shoots for bearing should be allowed to proceed, and also for subsidiary branches, where space admits of such. In our climate, the extremities of the shoots do not usually become perfectly ripened, and this is one reason why they should gene-

rally be shortened back, more or less, according to circumstances. In shortening back the leading shoots, it is best to cut to a bud situated at the back of the branch, or nearly so, for if cut to one at either side, the young shoot forms a bend from where it proceeds, and if cut to a bud in front, it curves outwards; but when cut to a bud on the side next the wall, the branch grows quite straight. The form of the knife used for pruning the peach tree is represented in Fig. 230.

The directions for pruning the peach tree will be easily comprehended on reference to Figs. 225 and 226. In Fig. 226, the buds marked *a* are wood-buds, and all the others blossom-buds. In Fig. 225, we have two single wood-buds near the base of the shoot; then a twin-bud, consisting of a wood-bud and a fruit-bud; next a single-wood bud; then a triple-bud, composed of two blossom-buds and a wood-bud in the centre; then a single blossom-bud; and, finally, two blossom-buds, with a wood-bud between them, above which the shoot is cut. It would be wrong to cut to the next lower joint, or immediately above the single blossom-bud *a*, for that bud would not produce a shoot, and the branch would ultimately die back to the next wood-bud. In Fig. 226, there are only two wood-buds; one, which forms the growing point or apex, situated in the midst of a cluster of blossom-buds; the other near the base of the shoot. Therefore, in such cases, the shoot must either be left at all its length, or cut back above the wood-bud at the base. The latter is generally the preferable mode, for a succession shoot would be obtained; whereas, if not so cut back, the whole would be naked in the following year, with the exception of a slight elongation of the growing point.

In the peach tree, all wood that is more than one year old serves only to support shoots that do or may bear fruit; but enough of main branches, and others subsidiary to them, should be provided for, in order that a sufficiency of

bearing shoots in every part of the tree may be insured.

From what has been stated, it is presumed that the training of the main branches of the tree, and also the subsidiary ones, will be understood. The management of the bearing shoots, and of those which should be produced to form a succession to them, remains to be considered.

In Fig. 231, *a* represents a portion of a branch before the winter pruning; *b* and *c* are bearing shoots, which were shortened at the previous winter pruning, bore fruit in the following summer, and also produced the shoots *d* and *e* for succession. The shoots *b* and *c*, having once borne, will do so no more, and therefore they are cut off close to the origin of the succession shoots *d* and *e*. These succession shoots, like their predecessors, are shortened at the winter pruning, in order that whilst they bear fruit in the ensuing season, they may also produce, in their turn, shoots for succession. In general, every bearing shoot throughout the tree should have a young shoot for succession, and the nearer the young shoot springs from the base of the bearing shoot, the better. It may be encouraged from the side of the bearing shoot next the branch, as at *c*, or from the opposite side, as at *d*. If at any time a bud push closer to the branch than where *d* and *e* originated, it should be encouraged, and the stub, which results from repeatedly shortening back to near the base of the bearing shoots, can then be reduced. In fact, wherever there is an opportunity of obtaining a succession shoot from the old branch, it should not be neglected, provided there is room for such young shoot.

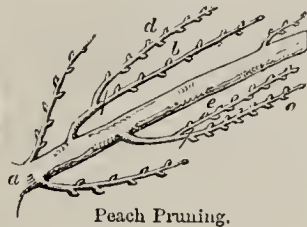
It will now be understood, that the peach tree must have a number of principal branches to constitute what may be termed the framework of the tree, and also subsidiary ones to fill up as the others diverge; the rest consists of bearing shoots, and from or near the bases of these, succession ones. These should be all managed according to the general principle above explained, that is, the bearing shoot is shortened, more or less, at the winter pruning. This has the effect of inducing shoots to push from the buds on the part left, and the lowest

Fig. 230.



Peach-pruning Knife.

Fig. 231



of these shoots is to be selected to form a succession; for the bearing shoot, unless it be the leading shoot of a branch, must be cut away at the winter pruning. From this it appears that the pruning and training of the peach tree, when it is once formed, is reduced to three very simple proceedings:—

1. Shortening the intended bearing shoot at the winter pruning.

2. Training a succession one in summer.

3. The removal of the shoots that have borne fruit, except such of them as are leading shoots of branches.

The length to which the bearing shoots ought to be shortened depends on their vigour, and, occasionally, the position of wood-buds; for in order to cut immediately above one of them, the shoot may have to be cut much shorter, or left at greater length than would otherwise be advisable.

The distance along the branches, from one bearing shoot to the other, may be about 1 foot or 14 inches. On a branch that is weaker than it ought to be, more succession shoots should be encouraged than on the adjoining stronger ones, and more space should be allowed them, by training those from the stronger branch in a limited space.

Disbudding.—This consists in the removal of buds, or rather shoots in a very young state. It is evident, that if all the young shoots were allowed to grow, they would soon become excessively crowded; it is therefore necessary that all should be removed, except those for which there is sufficient space. The operation ought to be commenced by the removal of those situated in front of the strongest branches, especially if these are in connection with branches too strong for the others. Then, in a day or two, those in front of branches or shoots lower down, should be pruned off. Next, a portion of those on the bearing shoots ought to be taken off; but in doing this care must be taken to preserve the lowest shoot on each for succession. Those having fruit at their bases should also be left untouched at present. According to the state of the weather, and, consequently, according to the greater or less activity of vegetation, the process of disbudding should be regulated. If the weather proves ungenial, and vegetation is languid, it is not advisable to disbud much at that time; if, on the contrary, the days and nights are warm, disbudding should be more closely followed up.

Vegetation may commence with a considerable degree of activity, but frequently cold weather ensues, and the slightly developed leaves linger or remain in a stationary condition. When they are in this state it is better to refrain from disbudding till vegetation again become active. Every bud that is being developed maintains a circulation of sap in its vicinity, but when a bud, or the young shoot resulting from it, is pinched or cut off, the circulation depending upon it must cease, or find other channels. In the former case, stagnation of the fluids proves injurious to the general health of the tree; but if the sap readily finds other channels, the circulation undergoes comparatively little derangement. When the young leaves are expanding slowly, in consequence of low temperature, we may remove from a shoot every pushing bud except one, and yet that one will scarcely be excited to a more rapid development. If we at once remove nine buds from a shoot, and leave only one, that one, under any circumstances, will not be prepared to receive the sap which was in movement towards the other nine. In order that the disbudded shoot may continue healthy, the disbudding should be performed by degrees. The forerights, in the first place, and then the others, should be gradually thinned away, till no more shoots and foliage are left than there is room to fully expose to light. The leading young shoot of branches intended to be prolonged should be trained at full length. The terminal young shoot of bearing branches ought to be allowed to grow till its lower leaves are nearly full sized, and then it should be shortened to 3 inches. Other young shoots having fruit at their bases should also be cut or pinched back to three or four leaves; and, when the fruit is thinned, many of such shoots, from the bases of which the fruit is removed, may be dispensed with. It will sometimes happen, that on shoots laid in for bearing there will be no fruit. When this is found to be the case, they may be cut off at the base, and the succession shoot trained in their place. When any of the succession shoots appear likely to become too vigorous, their tops must be pinched off, but it would be desirable that this should be done not lower than 1 foot or 15 inches from their bases.

Thinning the Fruit.—If the tree is in a healthy state, and the flow of sap distributed as equally as possible throughout the respec-

tive branches, the fruit will set in much greater abundance than could be properly matured, and few will drop, unless injured by frost when in a young state. It must therefore be thinned. To what extent thinning should be carried, depends on the vigour of the tree and natural size of the fruit. If the tree is weakly, its fruit should be left thin, as compared with that on a tree that is vigorous; and on weak branches fewer fruit should be left than on the more vigorous branches of the same tree. Large-fruited varieties, all other circumstances being the same, require more thinning than those that are small. Nectarines, being generally smaller than such peaches as the Noblesse, Barrington, &c., need not be so much thinned as these. A vigorous tree of good size may be allowed to bear as many as twenty dozens, and the fruit, if the foliage is healthy, ought to be large and fine. Trees are sometimes allowed to bear almost as many fruits as they will; the consequence is, that the trees are weakened in producing a great number of stones, but the quantity of flesh is by no means in proportion, and the quality is very inferior. The fruits, though numerous, are small, thin fleshed, sour, and would be reckoned unfit for use by those accustomed to eat peaches or nectarines in perfection.

If there has been no frost to injure the kernels in spring, the fruits may be pretty well thinned at once; but, however healthy the tree may be, if the kernel is injured from the above-mentioned cause, the fruit is very liable to drop, and therefore it is necessary to leave a greater number till such time as the stone is formed. The first thinning should take place when the fruit is scarcely the size of a hazel nut. By that time it will be seen that some of the fruits are larger than others. The smallest, of course, should be dispensed with. In removing the superfluous fruits, care should be taken not to tear the bark of the shoots, as is likely to be the case if the fruit is pulled backwards towards the base of the shoot. The fruit should be a little twisted and pressed in the opposite direction, or it may be cut or clipped off.

Other Culture.—With regard to the routine culture during the summer, besides the operations of pruning and training, one of the most essential points to be attended to is the condition of the roots in respect to moisture. In one week, the roots may have just enough

moisture, and if the weather is hot, the tree will make shoots and foliage with great rapidity; in the second week, rain may not fall in sufficient quantity to reach down to the roots, which have then to meet an increased demand from a diminished source of supply; and in the third week, the tree exhibits symptoms of disease. The leaves droop and lose their healthy green hue; and although this appearance may have the effect of causing the watering tubs to be employed, yet when full-grown leaves have once been allowed to droop and assume a yellowish, sickly tinge, they cannot again be brought quite to their former healthy condition, even if the attacks of insects, induced by dryness, had not to be taken into account. It is much easier to keep a tree healthy than to recover it after it has been allowed to become sickly. Let the border, therefore, be frequently inspected to the depth of the roots. If necessary, let the soil be forked over in ridges, and let the hollows be filled and refilled with water till the border is thoroughly moistened to the bottom. When the top soil has dried, so as to be in working condition, it should be levelled; and if a good mulching of stable litter can be given, it will keep the ground longer moist, as well as afford good nourishment to assist the swelling of the fruit.

When the trees are kept in a proper condition as regards moisture at the root, less syringing will be necessary; nevertheless, it is very beneficial. It is a good plan to syringe not only the trees, but the whole wall, several times before the flowers begin to open. It must be discontinued whilst the trees are in bloom, but it should be resumed as soon as the fruit is set. At that early period, and whilst the nights are cold, it is best to syringe early in the morning; later in the season, four p.m. is a good time to commence.

By taking care that the soil about the roots is never allowed to become too dry, and by syringing the foliage, the destructive attacks of the red spider will be prevented; finally, by syringing the trees, and then dusting them with snuff or powdered tobacco leaves, the green fly will be annihilated. Attention to these matters will insure a healthy foliage, and, consequently, healthy shoots; and if these are properly managed, according to the directions given for pruning and training, well-grown trees and abundant crops will be insured, where the climate is at all favourable.

When the fruit approaches maturity, it should be exposed to the direct rays of the sun, by putting aside any leaves that shade it. By so doing, the fruit becomes sooner and better ripened. In cold seasons and rather unfavourable situations, this should be more especially attended to.

Gathering.—Instruments of a funnel shape, lined with velvet or other soft substance, have been recommended for gathering peaches without handling them, but nothing is better than the hand; for, with it, the fruit can be grasped and pulled without touching the crown or part next the sun. The peach should be taken in the hollow of the hand, and the softest parts of the thumb and all the fingers applied, as much as possible, behind the fruit. If the latter is perfectly ripe, it will easily part from the tree; so easily, indeed, that when the whole pressure is divided among the parts brought in contact with it, no place can be bruised. The fruit is often well coloured next the sun before it is ripe, the part next the wall being still green; but afterwards the green acquires a yellow tinge, by which the ripening can be known. Peaches may be gathered in the heat of the day, without suffering any deterioration as regards flavour.

Diseases and Insects.—If the peach tree is managed as we have recommended, it will generally be healthy. Under the best management, however, some trees will become diseased.

Gumming is the most to be dreaded, and is very difficult to cure; indeed, if it pervades the tree to any considerable extent, the sooner the latter is dug up and replaced by a healthy subject the better. If the symptoms are but slight, the bark should be frequently well washed with a brush and water; this ought to be done in moist weather. The disease is apt to occur when the trees are planted in soil too richly manured, and whenever strong shoots are allowed to grow as much as they will, and are then cut back. It is not well to plant the tree with too much manure; but if that has been done, and the tree is inclined to over-luxuriance, the greater care must be taken to divide the sap among the branches by judicious summer pruning, so that there may be no large pieces to cut out at the winter pruning.

The *mildew* is also very destructive, but may be got rid of by means of flowers of sulphur, which should be applied on the first

appearance of the disease. Indeed, it is a good plan to dust the trees over before mildew makes its appearance at all.

Blistered leaves are occasioned by cold, and particularly when this occurs after warm weather. The growth of the midrib is arrested, and the circulation of the sap being obstructed, the leaves, or part of them, become swollen, inert masses. There is no cure. The preventive is, of course, warm covering. The leaves that are most affected should be taken off at once, and those that are partially so as soon as warm weather sets in to produce fresh healthy foliage.

The *yellows* is a disease little heard of, except in America, where it destroys whole orchards in a few years. It invariably manifests itself in trees growing on the peach stock, and, consequently, in order to avoid it, they should be worked on the plum or on the almond.

Sun-burning.—The bark of trees becomes scorched, in consequence of exposure to the sun's rays. These take most effect on the stem and thick naked branches; to guard against ill effects arising from this cause, the former should be protected with tiles, slates, or any other suitable material, the latter by training some of the young shoots over them.

The peach or poplar saw-fly (*Tenthredo populi*) deposits its eggs on the leaves of the peach and apricot in spring; and from them is hatched, in a few days, a pale green grub, which soon afterwards spins itself a web for protection, and begins to feed upon the foliage. When it has attained its full size, it descends to the ground, and spins itself a cocoon in the earth, where it remains till about the middle of April, when the perfect insect makes its appearance. Searching for the eggs at the time they are deposited, and burning the leaves upon which they are found, is the best preventive; but if not observed in time, the trees must be freed from the larvæ by hand-picking.

The red-legged garden weevil (*Otiorhynchus tenebriosus*), a small, black beetle, sometimes does great mischief to peach and apricot trees by devouring the buds, leaves, and young shoots. The beetles hide themselves during the day in the earth round the stem of the tree, or in crevices in the wall, from which they emerge at night to carry on their ravages. Hand-picking at night, and pouring boiling water over the beetles, is the only known

means of effecting their destruction. It is better, however, to kill the larvæ, which are destructive to the roots of most fruit-trees and vegetables, by removing the soil from the foot of the wall and sprinkling salt upon it.

The caterpillars of the figure-of-8-moth (*Episema cœruleocephala*) are very partial to the leaves of the peach; and, whenever observed, should be removed by hand-picking. The plum-tree tortrix (*Tortrix Wæberiana*) also attacks the peach and apricot. The means already recommended should be adopted for its destruction. The garden-chafer (*Anisoplia horticola*) feeds upon the leaves and flowers; it should, therefore, be sought after and destroyed whenever it appears, a trouble which is frequently rendered unnecessary by the formidable enemies which this insect finds in sparrows and several other birds.

Aphides often prove troublesome; and, as they multiply with astonishing rapidity, unless destroyed on their first appearance, prove very injurious. Fumigation, syringing, and afterwards dusting with snuff, powdered tobacco, and syringing with a decoction of tobacco, are the most approved remedies.

The red spider (*Acarus telarius*) and thrips attack the peach; but, if the trees are properly managed, are seldom very troublesome in the open ground. Should they, however, make their appearance, they must be destroyed by the application of sulphur, and by copious syringing.

Earwigs and ants are very destructive to the ripe fruit; the former are easily trapped, by dozens, in pieces of bean-stalk 6 or 8 inches in length, and from which they should be blown every morning into a bottle of water. The ants may be driven away by frequently hoeing the border; and by raking it from time to time, the more redoubtable attacks of biped depredators may, in most cases, be almost entirely prevented.

THE ALMOND (*Amygdalus communis*, L.—*Icosandria Monogynia*, L.; *Rosaceæ*, D. C.; *Drupaceæ*, Lind.) is a deciduous tree, growing to the height of 15 or 20 feet, a native of the warmer parts of Asia. The fruit consists of a dry or fleshy husk, and a shell of a greater or less degree of hardness, containing a kernel, which is sweet or bitter according to the variety, and which is the edible portion. The kernel of the sweet varieties is eaten at the dessert, and is largely used in confectionery and cookery. It also yields an oil, which is

employed in medicine and the arts, especially in perfumery. The bitter almonds are used in the production of noyau, and for flavouring confectionery. They are poisonous to birds and animals, a property which is due to their containing hydrocyanic acid; they also yield an oil which is extensively used in flavouring, but great caution should be exercised in its use, as it is very poisonous.

The almond seldom bears any considerable quantity of fruit, even in the southern parts of the kingdom; for the blossoms appearing in March, and sometimes in February, are frequently destroyed by frost; and even if they do escape, there is rarely sufficient sun heat to ripen the fruit as well as that imported from the south of France, and which can be purchased at a cheaper rate than almonds could be produced in this country. The tree is, therefore, rarely planted for any other purpose than ornament, or occasionally as a stock for the peach and nectarine.

Little is known respecting the comparative merits in this country of the varieties; and the following particulars as to the principal sorts are, with the exception of such synonyms as could be discovered in the present imperfect state of our knowledge, chiefly taken upon the authority of M. Vilmorin, in the *Transactions of the Horticultural Society of London*, vol. iv. p. 408:—

1. **COMMON**—syn. Common Sweet, Amandier Commun, Amandier à petit fruit, Amande Commune.—Nut about $1\frac{1}{4}$ inch in length; shell hard and smooth, terminating in a sharp point; kernel small, sweet, but inferior to that of the other kinds. It is productive, and the sort most commonly cultivated in France. According to Downing, it is one of the most hardy and productive kinds in the climate of New York. It is frequently used as a stock for the peach.

2. **HARD-SHELLED SWEET**—syn. Amande douce à coque dure.—Nut about $1\frac{1}{2}$ inch long, smooth, and of a dull colour; shell thick and hard; kernel small. It only differs from the Common in having larger fruit; it is the sort preferred for stocks.

3. **SOFT-SHELLED SWEET**—syn. Amande douce à coque tendre, Amande Sultane à coque tendre—resembles the preceding, but has a tender shell; kernel sweet and of good flavour, usually eaten in a young state. Very productive in France.

4. **LADIES' ALMOND**—syn. Amandier des

Dames, Amande des Dames, Amande Princepe, Amande à coque très tendre.—Nut oval, more than 1 inch in length; shell of a light colour, porous, and so tender that it can be broken between the fingers; kernel sweet and rich. It is considered the best sort, but appears not to be so hardy as the Common. This variety is synonymous with the *Amandier à coque tendre* of Duhamel, and perhaps, therefore, the same as the Soft-shelled Sweet Almond.

5. SULTANA ALMOND—syn. Amandier Sultane, Amande Sultane.—The nut resembles that of the Ladies' Almond, but is smaller; and it is, probably, only a trifling variation of that sort. The tree is not an abundant bearer, and is peculiar to the south of France.

6. PISTACHIA ALMOND—syn. Amandier Pistache, Amande Pistache.—The nut of this is small, somewhat resembling a pistachia nut in size and form.

7. BITTER ALMOND.—This differs little from the Common, except in the kernel being bitter. The shell is generally hard and of a dark colour; but there are several sub-varieties, differing in the size of the nut, as well as in the colour and thickness of the shell.

8. PEACH ALMOND—syn. Amandier Pêcher, Amande Pêche, Amande à pulpe.—This appears to be a cross between the peach and almond. It produces two kinds of fruit on the same tree, and sometimes on the same branch. The one is large, fleshy, and succulent, like a peach, but bitter, and only edible when cooked; the other has only a dry husk like the almond. They both contain a stone with a tolerably sweet kernel.

The almond prefers a warm, deep soil, well drained, and not too heavy. It also requires a sheltered situation, and a warm aspect. Propagation is effected by seed, and by budding on the almond or on the plum stock, for the perpetuation of the varieties. In raising from seed, the finest and most perfectly ripened almonds should be selected and stratified in damp sand, in November. When they have germinated, they may be planted in March or April, 2 inches deep, in light, rich, well dug ground, and in a warm situation. They may be placed 18 inches apart, in rows 2 feet asunder, and many of them may be budded near the ground the same year, or standard high when two or three years older. In the autumn of the year after budding, the young trees may be planted where they are to re-

main; they should be carefully taken up, so as to preserve the fibrous roots as much as possible, and the tap roots should be shortened by about one-third of their length. They ought then to be planted in well-trenched ground, and supported with stakes till well established.

Though the almond stock is generally to be preferred, yet when the subsoil where the trees are to be grown is of a cold, moist, heavy nature, and where the surface soil is shallow, it is generally better to bud upon the plum, as its roots do not strike so deeply into the ground, and are not so liable to suffer from an excess of humidity. The almond may be trained as a standard, half standard, dwarf standard, or as a pyramid; and, in respect to pruning, it may be treated like the apricot. If fruit be produced, as sometimes happens, it may either be gathered whilst the shell is soft for immediate use, or it may remain on the trees till it drop. After gathering, the husks should be taken off and the nuts spread out on the shelves of the fruit-room to dry. Afterwards, they may be packed in dry, clean sand, and kept in a dry, cool place.

CHAPTER XVIII.

THE GOOSEBERRY, CURRANT, RASPBERRY,
STRAWBERRY, ELDER, MULBERRY,
CRANBERRY, &c.

THE GOOSEBERRY (*Ribes Grossularia*, L., and *Ribes Uva-crispa*, L.—Pentandria Monogynia, L.; Grossularicæ, D. C.; Grossulariaceæ, Lind.) is a deciduous shrub, a native of Britain and other parts of Europe. The plant is very hardy, although the blossoms and young fruit are very liable to be destroyed by late spring frosts. It succeeds, near the level of the sea, in the most northern parts of the island, and even far above that level as far north as latitude $57^{\circ} 15'$; for, according to some interesting observations made by the Rev. James Farquharson, of Alford, and published in Murray's *Encyclopedia of Geography*, it only ceases to be productive at an elevation of 900 feet. The gooseberry not only grows and bears well in the comparatively cool climate of Scotland and the north of England, but the fruit is also better flavoured than in the hotter parts of the south. The fruit is not so good when it is rapidly brought to maturity by very hot

weather, as it is when brought forward slowly by a moderate temperature. At Alford the mean temperature of July is about 56° or 57° , and that of August about 56° ; at Glasgow, the mean of those months is respectively 61.25° and 59.78° ; at Manchester, about the same; and at Lancaster, 57.71° and 57.05° . At these places the fruit acquires its full richness of flavour; but near London, where the mean of July is about 63° , and that of August about 62° , it is frequently overheated in ripening; the large sorts with thin skins appear as if parboiled, especially where the soil is not tender, rich, well manured, and moist, likewise where the trees are pruned so as not to afford sufficient shade.

In consequence of the great number of gooseberry shows held in Lancashire, Cheshire, and Yorkshire, the cultivation of this fruit has been carried to a wonderful perfection as regards size, but the prizes being almost exclusively offered for the heaviest berries, the improvement as regards flavour has not progressed in a corresponding degree in these districts. This is to be regretted; for, doubtless, if prizes were offered for seedlings of the best flavour, sorts superior in this respect would be produced. Many of the varieties that are large and coarse are, however, very useful for culinary purposes, for the young fruit soon acquires a size fit for pies, tarts, and puddings; hence they are of great importance in the neighbourhood of large towns. In this way the gooseberry, though not the first ripe, is of all hardy fruits the earliest fit for use.

Of the varieties, which are very numerous, the following are amongst the most esteemed:—

CLASS I.—FRUIT RED.

§ 1.—*Surface hispid.*

1. RED CHAMPAGNE—syn. Countess of Errol, Dr. Davis's Upright, Red Turkey and Ironmonger of some.—*Branches* remarkably erect. *Fruit* small, roundish oblong, hairy, light red, rather thick-skinned, very rich and excellent, with a clear vinous pulp. Middling early, and a good bearer.

2. RED WARRINGTON—syn. Aston, Aston Seedling, Volunteer.—*Branches* pendulous, armed with strong prickles, which are generally triple. *Fruit* roundish oblong, hairy, red, thick-skinned, with a clear, rich, vinous pulp. Late, and an abundant bearer. One of the best sorts.

3. SCOTCH BEST JAM—syn. Dumpling, Ironmonger of some.—*Branches* erect. *Leaves* pubescent above. *Fruit* small, roundish, slightly hairy, dark red, thick-skinned, brisk, and rich. Middling early, and a good bearer.

4. IRONMONGER—syn. Hairy Black.—*Branches* spreading. *Leaves* pubescent. *Fruit* small, roundish, hairy, dark red, with rather a thick skin, rich, and very good,

but not so rich as the Red Champagne, with which it is often confounded. Middling early.

5. RASPBERRY—syn. Old Preserver.—*Branches* spreading, somewhat pendulous. *Fruit* small, roundish oblong, hairy, dark red, thick-skinned, rich, and sweet, with a raspberry flavour. Very early, and a good bearer.

6. IRISH PLUM—*Branches* erect. *Fruit* middle-sized, roundish, hairy, dark red, thick-skinned, vinous, and rich. Middling early.

7. KEENS' SEEDLING—syn. Keens' Seedling Warrington.—*Branches* somewhat pendulous. *Fruit* middle-sized, oblong, very hairy, bright red, thin-skinned, rich, and excellent. A good bearer, ripening earlier than the Red Warrington.

8. ROUGH RED—syn. Little Red Hairy, Old Scotch Red, Thick-skinned Red.—*Branches* spreading, rather upright. *Leaves* smooth. *Fruit* small, roundish, very hairy, dark red, rather thick-skinned, of good flavour. Early, and an abundant bearer. Esteemed for preserving.

9. SMALL DARK ROUGH RED—syn. Small Rough Red.—*Branches* spreading, rather upright. *Leaves* pubescent. *Fruit* small, round, very hairy, dark red, nearly black when fully ripe, rather thick-skinned, of good flavour. Early, and an abundant bearer.

10. ROB ROY.—*Branches* erect. *Fruit* middle-sized, obovate, hairy, pale red, of rich flavour. Very early.

11. BEAUMONT'S RED.—*Branches* very erect. *Leaves* pubescent above, dark green. *Fruit* middle-sized, roundish oblong, very hairy, dark red, nearly black when fully ripe, thin-skinned, rich, and sweet. Very early, and a moderate bearer.

12. RED MOGUL.—*Branches* spreading, somewhat pendulous. *Leaves* smooth. *Fruit* small, roundish oblong, hairy, red, thin-skinned, sweet, and very good. Middling early, and a good bearer.

13. LARGE RED OVAL.—*Branches* spreading. *Fruit* large, oval, hairy, bright red, thick-skinned, vinous, and rich. Rather late, and a good bearer.

14. LEIGH'S RIFLEMAN—syn. Allcock's Duke of York, Grange's Admirable, Yates's Royal Anne.—*Branches* somewhat erect. *Fruit* very large, roundish oblong, hairy, red intermixed with green, thick-skinned, sharp, rich, and agreeable. Late, and a good bearer.

15. BRATHERTON'S LORD OF THE MANOR.—*Branches* spreading. *Fruit* very large, roundish, hairy, red, rather thick-skinned, very good. Late, and a good bearer.

16. LOMAS'S VICTORY.—*Branches* somewhat pendulous. *Fruit* rather large, roundish oblong, hairy, light red, thin-skinned, of moderately good flavour. The unripe berries are esteemed for cooking.

17. MILLING'S CROWN BOB.—*Branches* pendulous. *Fruit* very large, roundish oblong, hairy, red mixed with green near the stalk, bright red towards the opposite end, thin-skinned, and of good flavour. Rather late; an abundant bearer.

18. DENNY'S SHAKESPEARE.—*Branches* erect. *Fruit* very large, roundish, hairy, red, thick-skinned, and well flavoured. Late.

19. CHESHIRE LADY.—*Branches* erect. *Leaves* pubescent. *Fruit* middle-sized, oblong, hairy, deep red, rich, and excellent, with a clear pulp. Rather late.

§ 2.—*Surface downy.*

20. MISS BOLD—syn. Pigeon's Egg of some.—*Branches* spreading, somewhat erect. *Leaves* pubescent above. *Fruit* middle-sized, roundish oblong, very downy, sometimes slightly hairy, light red, tender-skinned, sweet, and of very good flavour. Early, and an abundant bearer.

21. BERRY'S FARMER'S GLORY.—*Branches* somewhat pendulous. *Leaves* slightly pubescent above. *Fruit* very large, obovate, downy, red intermixed with green, thick-skinned, well flavoured. Middling early; an abundant bearer.

22. HAMPSON'S TANTARARARA.—*Branches* erect. *Leaves* pubescent. *Fruit* middle-sized, obovate, downy, red, very good. Middling early.

§ 3.—*Surface smooth.*

23. SMALL RED GLOBE—syn. Smooth Scotch.—*Branches* erect. *Leaves* shining, dark green. *Fruit* small, roundish, generally smooth, sometimes slightly hairy, dark red, thick-skinned, sharp, and rich. Rather late, and a good bearer.

24. RED TURKEY—syn. Smooth Red.—*Branches* somewhat erect. *Fruit* small, obovate, smooth, shining, dark red, thick-skinned, of an agreeable, sweet flavour. Late, and a good bearer.

25. RIDER'S SCENTED LEMON.—*Branches* spreading. *Fruit* large, obovate, smooth, red, moderately thick-skinned, very good. Rather late, and an abundant bearer.

CLASS II.—FRUIT YELLOW.

§ 4.—*Surface hispid.*

26. YELLOW CHAMPAGNE—syn. Hairy Amber—*Branches* erect. *Fruit* small, roundish oblong, hairy, yellow, thin-skinned, rich and excellent. Rather late; an abundant bearer. The best yellow-fruited variety.

27. SULPHUR—syn. Rough Yellow.—*Branches* erect. *Fruit* small, roundish, hairy, yellow, moderately thick-skinned, of rich flavour. Rather late; a good bearer.

28. HEBBURN YELLOW ASTON.—*Branches* erect. *Fruit* small, roundish oblong, hairy, deep yellow, thin-skinned, very good. Middling early; an abundant bearer.

29. YELLOWSMITH.—*Branches* erect. *Fruit* small, roundish oblong, hairy, yellow, rather thin-skinned, sweet and rich. Middling early, and a good bearer.

30. EARLY SULPHUR—syn. Golden Ball, Golden Bull, Moss's Seedling.—*Branches* erect, armed with numerous strong prickles, which are generally triple. *Leaves* light green, pubescent above. *Fruit* middle-sized, roundish oblong, very hairy, bright yellow, thin-skinned, tolerably good. Very early, and an abundant bearer. Its earliness is its principal merit. It is distinguished from the Sulphur by its earliness, and the leaves being pubescent.

§ 5.—*Surface downy.*

31. RUMBULLION—syn. Round Yellow, Yellow Globe.—*Branches* erect. *Fruit* small, roundish oblong, very downy, pale yellow, rather thick-skinned, of moderately good flavour. Middling early, and a very abundant bearer. It is much cultivated for bottling.

§ 6.—*Surface smooth.*

32. BEAUMONT'S SMILING BEAUTY.—*Branches* somewhat pendulous. *Fruit* large, oblong, quite smooth, yellowish white, thin-skinned, somewhat transparent, sweet, and good. Early, and an abundant bearer.

33. YELLOW BALL.—*Branches* erect. *Fruit* middle-sized, roundish, smooth, yellow, thick-skinned, of good flavour. Deserving of cultivation on account of its lateness.

CLASS III.—FRUIT GREEN.

§ 7.—*Surface hispid.*

34. EARLY GREEN HAIRY—syn. Early Green, Green Gaseigne.—*Branches* erect. *Leaves* dark green, slightly pubescent. *Fruit* small, round, hairy, deep green, thin-

skinned, very sweet, and rich. Very early; a good bearer.

35. HEBBURN GREEN PROLIFIC.—*Branches* erect. *Fruit* middle-sized, roundish, hairy, dull green, rather thick-skinned, sweet, and very rich. Early, and an abundant bearer.

36. GLENTON GREEN—syn. York Seedling.—*Branches* somewhat pendulous. *Leaves* pubescent above. *Fruit* middle-sized, oblong, narrower at the base than at the opposite end, very hairy, green, with whitish veins, thick-skinned, very sweet, and good. Early.

37. HOPLEY'S LORD CREWE.—*Branches* erect. *Fruit* very large, oblong or roundish oval, slightly hairy, green, with a moderately thick skin, of tolerably good flavour. Rather late; a good bearer.

§ 8.—*Surface downy.*

38. GREGORY'S PERFECTION.—*Branches* pendulous, very prickly. *Fruit* middle-sized, round, slightly downy, green, veined with white, rather thick-skinned, sweet, and agreeable. Late; a moderate bearer.

39. PARKINSON'S LAUREL—syn. Green Laurel.—*Branches* erect. *Fruit* large, obovate, very downy, pale green, nearly white, thin-skinned, very sweet. Rather late, and an abundant bearer.

40. COLLIER'S JOLLY ANGLER—syn. Collins's Jolly Angler, Lay's Jolly Angler.—*Branches* erect. *Fruit* large, oblong, downy, light green, thin-skinned, of good flavour. Late, and a good bearer.

§ 9.—*Surface smooth.*

41. LARGE SMOOTH GREEN.—*Branches* spreading. *Fruit* large, obovate, smooth, pale green, thick-skinned, very good. Late.

42. PITMASTON GREEN GAGE.—*Branches* erect. *Fruit* small, obovate, smooth, green, rather thick-skinned, rich, very sugary, and excellent. Late, and an abundant bearer. The fruit will hang till it shrivels without deteriorating in flavour, like that of most other varieties.

43. EDWARDS' JOLLY TAR.—*Branches* somewhat pendulous. *Leaves* rather large, of a shining deep green colour. *Fruit* very large, roundish obovate, smooth, green, veined with yellow, rather thick-skinned, rich and sweet. Middling early; a good bearer.

44. MASSEY'S HEART OF OAK.—*Branches* pendulous. *Fruit* large, oblong, with a thick footstalk tapering into the fruit, smooth, green, with pale yellowish veins, thin-skinned, rich, and excellent. Middling early; an abundant bearer.

45. ALLEN'S GLORY OF RATCLIFF.—*Branches* spreading, somewhat pendulous. *Fruit* middle-sized, oblong, quite smooth, light green, thick-skinned, very good, and sweet. Middling early; a moderate bearer.

46. GREEN WALNUT—syn. Nonpareil, Smooth Green, Belmont's Green of some.—*Branches* spreading. *Leaves* adpressed to the branches. *Fruit* middle-sized, obovate, smooth, dull dark green, very thin-skinned, sweet, moderately good. Early, and an abundant bearer.

CLASS IV.—FRUIT WHITE.

§ 10.—*Surface hispid.*

47. ADAMS'S SNOW-BALL.—*Branches* pendulous. *Fruit* middle-sized or rather large, roundish, slightly hairy, rich, and sweet. Middling early.

48. WHITE CHAMPAGNE.—*Branches* very erect. *Leaves* pubescent above. *Fruit* small, roundish oblong, hairy, slightly downy, white, rather thick-skinned, sweet, and rich. Middling early; a moderate bearer.

49. **WHITE CRYSTAL.**—*Branches* erect or spreading. *Leaves* small, slightly pubescent. *Fruit* small, roundish, slightly hairy, very downy, with a thin transparent skin, rich, and sweet. Early, and an abundant bearer.

50. **IRISH WHITE RASPBERRY**—syn. Henderson's Porcupine, Hedgehog.—*Branches* erect. *Leaves* pubescent. *Fruit* middle-sized or rather small, roundish, very hairy, white, rather thin-skinned, rich, and excellent. Middling early; a good bearer.

51. **TAYLOR'S BRIGHT VENUS.**—*Branches* erect. *Fruit* middle-sized, obovate, very slightly hairy, white, sugary, rich, and excellent, hanging till it shrivels. Middling early; a good bearer.

52. **CLEWORTH'S WHITE LION.**—*Branches* somewhat pendulous. *Fruit* large, obovate, slightly hairy, white, thin-skinned, rich, and excellent. Very late.

53. **ROYAL WHITE.**—*Branches* erect. *Leaves* pubescent. *Fruit* small, round, downy and slightly hairy, white, thin-skinned, very rich, and good.

54. **JACKSON'S ABRAHAM NEWLAND.**—*Branches* erect. *Fruit* large, oblong, slightly hairy, white, rich, sweet, and excellent. Late.

§ 11.—*Surface downy.*

55. **WOODWARD'S WHITESMITH**—syn. Whitesmith, Grundy's Lady Lilford, Hall's Seedling, Lancashire Lass, Sir Sidney Smith.—*Branches* erect. *Fruit* large, roundish oblong, very downy, white, thin-skinned, excellent. A variety rarely equalled, scarcely ever excelled. Middling early; an abundant bearer.

56. **LARGE EARLY WHITE.**—*Branches* erect. *Fruit* large, obovate, downy, greenish white, thin-skinned, and of rich flavour. Very early.

57. **SAUNDERS'S CHESHIRE LASS.**—*Branches* erect. *Fruit* large, oblong, downy, white, thin-skinned, rich, and sweet. Very early, and a good bearer.

58. **EARLY WHITE.**—*Branches* spreading. *Fruit* roundish oblong, slightly downy, yellowish white, with a thin transparent skin, very sweet, and well flavoured. Early, and an abundant bearer.

59. **STRINGER'S MAID OF THE MILL.**—*Branches* erect. *Fruit* large, roundish oblong, or somewhat ovate, very downy, white, thin-skinned, excellent. Early, and an abundant bearer.

60. **CRYSTAL.**—*Branches* spreading, somewhat pendulous. *Leaves* smooth above, deep green. *Fruit* small, roundish, smooth or slightly downy, white, thick-skinned, tolerably good. A good bearer, but its principal merit is its lateness.

§ 12.—*Surface smooth.*

61. **WHITE HONEY.**—*Branches* erect. *Fruit* small or middle-sized, roundish oval, generally smooth, white, rather thick-skinned, rich, and of excellent flavour.

62. **WHITE FIG.**—*Branches* erect. *Fruit* small, obovate, tapering to the stalk, smooth, white, rather thick-skinned, rich, and excellent. It will hang and shrivel on the plant like a raisin. The bush is not vigorous.

63. **WHITE DAMSON.**—*Branches* erect. *Fruit* small, roundish, smooth, greenish white, thin-skinned, excellent. Very early, and a good bearer.

64. **COOK'S WHITE EAGLE.**—*Branches* rather erect. *Fruit* large, obovate, smooth, white, thick-skinned, of good flavour.

65. **PEER'S QUEEN CHARLOTTE.**—*Branches* somewhat erect. *Fruit* middle-sized, oblong, smooth, yellowish white, thin-skinned, flavour very good. Early; a moderate bearer.

Propagation.—The gooseberry is easily propagated by seeds, cuttings, layers, and suckers. New varieties can, of course, only be obtained from seed. This should be taken from perfectly ripe fruit of the best flavour, and possessing other properties which it is desirable that the progeny should inherit. The seed ought to be washed, and merely dried on sheets of brown paper, but not hardened by exposure to the sun. They should then be sown in rich, sandy loam in the open ground, or in pots filled with loam, sand, and leaf-mould, covering in either case with about an inch deep of soil. Those sown in beds will be fit for transplanting into nursery rows in the following autumn. Those sown in pots may be forwarded by potting them singly, as soon as fit, into small pots, and taking care to shift again, or transplant, before the roots get in the least matted. The seedlings will generally come into bearing in the third or fourth year.

Propagation by cuttings is the usual mode, and is performed in autumn, winter, or spring; but early in autumn is the best time. Cuttings of almost any length may be struck, but vigorous firm-wooded shoots are the best. If the cuttings are taken off close to the branch from which they spring, so much the better. Their points should be cut off so as to leave the cutting 10 inches or 1 foot in length. The buds on the lower end ought to be cut out. The minute ones at the base should be strictly looked after, and completely eradicated. This disbudding ought to extend to the height of 6 inches from the base. The prickles may also be so far removed. The soil for the cuttings should be rich and free, as well as rather moist, or if otherwise, watering must be well attended to. The cuttings should be planted in lines 1 foot apart, and about 6 or 8 inches from each other in the row. Some plant with a dibber; but it is better to cut out a small trench by the side of a line, and, placing them with their lower end about 4 inches below the surface, to press the soil close to their base. It may be observed that roots are emitted from any part of the cutting below ground; therefore, it may be presumed that the deeper it is inserted the more roots will be produced. This is true to some extent; nevertheless, it is found that roots produced along a great length of shoot, like fibres from a tap root, are not so vigorous and effective as those which proceed from points nearer the leaves; at least this is the case with the gooseberry, which is not

naturally a tap-rooted plant. There may be some advantage whilst the elaborated sap of the long cutting is not exhausted; but afterwards, it must be recollected that before the returning sap from the leaves can reach the lower roots, it must deposit woody matter in its progress all along from the base of each leaf till it reach the fibres. If the cutting were $\frac{3}{4}$ inch in circumference, and inserted to the depth of 12 inches, and supposing that a considerable number of roots were emitted at that depth, then, before the returning sap could reach the lower roots, it must deposit a layer of woody matter over a surface of 9 square inches. If, however, the cutting were inserted only to the depth of four inches, then, all other circumstances being the same, the surface of the underground portion would be only 3 square inches, or only one-third of that of the cutting 12 inches deep, and leaving two-thirds more returning sap to go to the formation of roots. It has even been ascertained that a plant from a deeply inserted cutting succeeds better when its lower part is cut away in transplanting. From what has been stated, it is evident that the cutting must not be made very long, neither should it be deeply inserted in the ground; from 4 to 5 inches is, we consider, a proper depth.

Layering is a sure mode, and may be resorted to when plants of any particular sort are required to be speedily obtained, without risk of failure, though the plants are not so handsome as those raised from cuttings; but the most rapid mode of obtaining well-rooted plants, is by that which has been termed layering by insertion of the growing point. In moist seasons, it may have been observed that occasionally many of the pendulous Lancashire sorts naturally strike root in summer at the extremities, when these come in contact with the soil. If, towards the end of June, the tips of the shoots of any variety are inserted to the depth of an inch in soil that has been recently dug and made fine, they will form a large quantity of roots before autumn, together with a bud for a shoot. In autumn these plants will be so well rooted that they may be taken up, and either planted where they are to remain, or put in nursery rows till next autumn; but, in doing so, great care must be taken not to break the bud formed at the crown of the bundle of roots.

Propagation by suckers is generally considered objectionable, as the plants so obtained

are apt to produce suckers. In a well-managed plantation there should be no suckers to propagate from; but, in the case of scarce sorts, it may be advisable to encourage them for the sake of increase. They should be planted in autumn, and transplanted a year afterwards, on which occasion the roots, whilst out of the ground, ought to be closely examined, and every bud completely removed. By a little care, good plants with clean stems may be formed; and, if the shoots and leaves are kept healthy and vigorous, the disposition to produce suckers will be easily overcome.

Soil and Situation.—The gooseberry will succeed in any good garden soil that is sufficiently loose and permeable for its roots, and rather moist than dry. It does not grow well in stiff clays that become hard in hot, dry weather. For growing very large fruit, a compost may be employed, consisting of good turfy loam, plenty of rotten stable manure, and peat or leaf mould. This should be laid in a ridge, and frequently turned till the whole is well incorporated. The fruit is best flavoured from an open situation. The trees may be planted and trained against espaliers in the north, but in the southern parts of the kingdom, the fruit generally wants protection from the sun's rays, rather than exposure to them, when ripening; and, accordingly, it is found to succeed better in quarters in the bush form, one branch shading the other, than when the branches are individually exposed. They may, however, be planted anywhere on a north wall.

Planting.—In quarters, the planting may be done in the quincunx form; and, in this way, if the distance between the rows be 6 feet, that of the plants in the row will require to be 5 feet $2\frac{3}{8}$ inches. These we consider to be good medium distances, but in rich soil they may be increased, and in poor ground diminished. The bottom of the holes should be made convex; and in planting, the roots must be regularly spread out, and not deeper than they were before removal.

Pruning.—With regard to the pruning of gooseberry plants intended for quarters, the first thing to be considered is the height of the stem; for an equality of vigour would be very difficult to maintain between two or more, and if it were not, irregularity of growth would result. The stem should be kept clean to the height of 3 or 4 inches, so as to admit of the ground being dug, hoed, or raked close to the plants. If the cuttings allow of that

height, and have, at the same time, three buds above it for as many shoots, the height of the stem and point of origin of the primary branches may be considered as determined; but if the cutting is too short to admit of this, a shoot must be trained upright, and cut at the winter pruning, so as to afford 3 or 4 inches of clean stem and three buds for shoots, but, in case of accident, an additional bud may be preserved. When the three primary shoots from the cutting have made their first summer's growth, they should be shortened in autumn to about 6 inches in length. If any laterals have been produced, let these be cut back to their lowest eye. In the following season, from each of the three shoots that were shortened back in autumn, encourage two shoots, namely, one from a bud pointing to the right hand, and one from another pointing to the left. These shoots should be trained a little outwards in summer, when their wood becomes firm enough to bend without breaking; but in the south, the bushes must not be made so much cup-shaped, otherwise the fruit is apt to be scorched. The tree will now have six leading shoots; and in autumn these may be shortened to 7 or 8 inches. All other shoots ought to be *spurred*, or cut back to within an inch of their bases. The next subdivision of each of the leading shoots will, of course, produce twelve, which will be a sufficient number of branches, and then the tree may be considered to be perfectly formed. The branches should be, as nearly as possible, at equal distances; and, with this in view, if a shoot is seen approaching too near the adjoining one, it should be cut to a bud pointing somewhat in the opposite direction.

Either naturally, or in consequence of shortening the leading shoots, laterals will be produced. These should be cut back to one eye if weak, or two or three if strong. Shoots that start up with greater vigour than the generality ought to be stopped in summer, unless they are likely to be wanted to fill up a vacancy. When there is an equal degree of vigour in the respective branches, the tree will be more healthy than if some were allowed to be too weak, in consequence of others becoming too strong; and the fruit will also be finer flavoured. The largest fruit is, however, produced on vigorous shoots of the preceding summer; and therefore, when size is the object, young shoots must be encouraged to supply the place of old wood, which must be

cut away. According to Mr. Saul, of Lancaster, a very intelligent cultivator of the gooseberry, the Lancashire growers, who excel in growing very large gooseberries for prizes, transplant the young plants with three shoots, in the first instance, as we have recommended, only they incline them nearly to a horizontal position. For this purpose they employ hooked sticks to pull down the shoots that are inclined to grow upright, and forked ones to support those that are inclined to grow too drooping, as the shoots of many of the prize sorts are. By next autumn these three shoots will have produced a number of side shoots, most of which may be cut back to one eye, and the others to half their length. The less the number of shoots, and the younger the tree, the larger will be the fruit. In November the tree is pruned, so as to consist of the three primary shoots, each bearing two young shoots, which are shortened to about 7 inches in length. These last are pruned, in the following autumn, so as to have only two young shoots each; all the others are to be closely cut off.

"In all following years, the system of pruning and thinning which I particularly recommend, is to keep a moderate and constant supply of strong, healthy young shoots, from which alone can be expected large and fine fruit; and wherever the extremities grow beyond the proper bounds, such branches should be cut back, so as to keep the tree in a compact form, and furnished sufficiently, though rather thinly, with new bearing wood; for large fruit cannot be expected if the tree is too much crowded with old and young wood.

"It is not only to the branches and top of the tree," continues Mr. Saul, "that the care of those who wish to excel in the cultivation of the gooseberry must be directed; they must pay attention to the roots also, as it is necessary they should be pruned every two or three years. When a root, therefore, has extended too far from the stem, let it be uncovered, and all the strongest leaders shortened back nearly one-half of their length, and covered in with fresh marly loam. This will cause new and more active roots to be formed nearer the stem, and give the whole tree new vigour."—*Gardener's Magazine*, vol. iii. p. 422.

Trenches filled with compost or manure are formed round the tree in advance of the roots, into which these may strike root. This will insure plenty of nourishment; and, besides,

the trees are mulched and regularly supplied with water, both as regards the roots and foliage. The fruit is also thinned excessively, so as to leave only two or three on each branch. By these means, and by placing a saucer with water under the fruit, the latter attains an enormous size—upwards of $1\frac{3}{4}$ ounce in some cases. Under these circumstances, richness of flavour cannot be expected.

By the mode of pruning which we have described, the bushes will assume a concave form. This will be suitable for the northern and midland parts of the kingdom, but in the warmest parts of the south it exposes the fruit too much to the sun, and therefore many growers leave a few shoots in the middle. Some prune their bushes only every second year, only half their plantation being pruned in one season, and the other half the next. In the portion not pruned, the young fruit often escapes destruction from spring frosts, whilst that on the pruned trees, from being more exposed, is cut off; and, again, if excessively hot weather should set in when the fruit is ripening, the unpruned bushes afford more shade.

Gooseberries may be trained against espaliers or pales, in which case the fan mode is the most to be preferred, because it affords the greatest facility for training in a succession of young wood. They are also trained on arched trellises. For this purpose they ought to be planted 15 or 18 inches apart, and trained with a single stem, which should be shortened at the autumn pruning, in order that it may be well furnished with spurs and laterals to fill the space; but none of these laterals should be allowed to grow so strong as the leading shoot, otherwise it will not make good progress.

Other Culture.—Gooseberry plantations should be dressed in autumn, taking care, in stirring the soil, not to injure the roots. The surface of the soil near the stems ought to be drawn back towards the middle of the interval. Manure should be plentifully supplied; and the digging must be chiefly performed with the fork, especially near the roots.

Diseases and Insects.—We are not aware of any disease peculiar to the gooseberry; but it often suffers severely from the attacks of several destructive species of insects.

The magpie moth (*Abraxas grossulariata*) deposits its eggs upon the foliage, and from them is hatched, in September, a slightly hairy,

cream-coloured caterpillar, spotted with black, and marked with orange along the sides, and which forms a loop in walking. It feeds upon the leaves during autumn and spring, devouring all but the petiole, and often entirely defoliating both gooseberry and currant bushes. It changes into a pupa in May or June, and in about three weeks afterwards, the perfect insect makes its appearance. Hand-picking the caterpillars at an early stage of their growth, and, still better, burning the leaves on which the eggs are laid, are the troublesome means by which this destructive pest may be got rid of. Pouring over the bushes ammoniacal liquor diluted with water, is stated by Mr. Beaton to be the easiest mode of destroying the caterpillars; but, as he justly remarks, the strength of ammoniacal liquor varies greatly, it is therefore advisable to ascertain, by experiment, the least amount of dilution which will not prove injurious in the sun to the leaves of some useless plant with tender foliage, and then to add as much water as will insure the safety of the gooseberry leaves, without rendering the application too weak for the destruction of the insect.

Another destructive insect is the caterpillar of *Phalena Vauaria*. It is about an inch in length, of a bluish-green colour, dotted with black tubercles, has ten legs, and, like the caterpillar of the magpie moth, forms a loop in walking. It changes into a pupa towards the end of May, and the perfect insect appears in the following month, or in July. Hand-picking as soon as the larva is perceived, and dusting the bushes with hellebore powder, or with lime, are the means usually employed for its destruction; and, as the insect undergoes all its transformations on the ground, scattering newly slaked lime round the bushes when the caterpillars quit these, is perhaps the best means of preventing the repetition of the mischief in the following year.

The gooseberry and currant saw-fly (*Nematus Ribesii*) deposits its eggs on the under surface of the leaf, by the side of the principal nervures, early in spring, and successive broods of flies appear until October. The larvæ devour the leaves, leaving only the petiole; and when full grown, which is the case when they are about $\frac{3}{4}$ inch in length, descend to the earth, spin a cocoon, and change into pupæ, from which another brood of flies soon emerges. Burning the leaves upon which the eggs are laid, and hand-picking where the plantation is

not very extensive, syringing the bushes and then dusting with lime, which should also be scattered round the stems, and sprinkling the leaves with lime-water, are the remedies usually adopted. Removing early in spring the soil from round the bushes to the depth of 3 or 4 inches, and burying it in deep trenches in order to entomb the pupæ, is a good preventive measure. Syringing the bushes in the evening, and sprinkling them with salt or soot, as well as flowers of sulphur applied with a sulphurator, are likewise said to be infallible remedies. In addition to the formidable enemies above enumerated, birds frequently prove very destructive, by picking out the buds in spring. Little can be done to prevent their attacks in extensive plantations, but in small gardens the bushes may be covered with netting.

CURRANTS (*Ribes*—Pentandria Monogynia, L.; Grossulariæ, D.C.; Grossulariaceæ, Lind.)—Of these there are three principal sorts, the Red (*R. rubrum*, L.), the White, a pale-fruited variety of the same species, and the Black (*R. nigrum*, L.) Both species are indigenous to Britain. The red currant is extensively used for pies, tarts, and jellies; and both that and the white are employed for making currant wine. The white, being less acid than the red, is preferred for the dessert, to which however, for contrast, both sorts are occasionally introduced. The skin of the black currant contains an essential oil, which renders it disagreeable to many persons, still the fruit is in much request for preserving and for making wine. On the whole, currants are important objects of cultivation, especially in the neighbourhood of towns, where the fruit, during the long period of the season in which it is fit for use, is always in demand.

The most esteemed varieties are:—

1. **RED DUTCH**—syn. Large Red Dutch, New Red Dutch, Large Red, Large-bunched Red, Long-bunched Red, Red Grape, Grosseillier rouge à gros fruit.—Surpassed by none in size of bunch, quality, and abundant bearing.

2. **PITMASTON PROLIFIC**.—Bunches large. Berries large, and of a fine colour. An abundant bearer. A variety closely approaching the Red Dutch.

3. **KNIGHT'S LARGE RED**—syn. Lander's Red.—Leaves broad. Bunches large. Berries of a fine deep red. An abundant bearer; but in some situations the fruit is more apt to

mould than the Red Dutch, in consequence of being more compact, the berries being larger, whilst the raceme is shorter.

4. **RABY CASTLE**—syn. Houghton Castle, May's Victoria, Goliath.—Bunches long. Berries large, equal in size to those of Knight's Large Red, and ripening late. The variety is said to have been a seedling found in the garden at Houghton Castle, about fifty years ago.

5. **KNIGHT'S EARLY RED**.—Earlier than the Red Dutch, and less acid, but smaller, and not equal to it on the whole.

6. **KNIGHT'S SWEET RED**.—Berries smaller and less acid than those of the Red Dutch.

7. **WILMOT'S LARGE RED**—syn. Wilmot's Pale Red.—Berries larger and paler than those of the Red Dutch, which, however, is preferable, on account of the superior brilliancy of its colour.

8. **RED CHAMPAGNE**—syn. Grosseillier à fruit couleux de chair.—Berries pale red, intermediate in colour between the red and the white sorts, not so sweet as the latter, and less acid than the former.

9. **STRIPED FRUITED**—syn. Gross Weiss und Rothgestreifte Johannisbeere.—Berries similar to those of the Red Champagne in size and flavour, but distinctly striped, from the stalk to the eye, with white and red alternately.

10. **WHITE DUTCH**—syn. New White Dutch, Jeeves' White, Morgan's White, White Crystal, White Leghorn.—Bunches large and abundant. Berries large, transparent, yellowish white. The best white currant.

11. **WILMOT'S NEW WHITE**.—Bunches long, less compact than those of the White Dutch, and scarcely so large. The variety is very distinct, the leaves being more deeply lobed than those of any other.

12. **BLACK NAPLES**.—Bunches more abundant and berries larger, as well as more numerous, than in any other sort. The best black fruited variety. It may be distinguished in spring from other sorts, by its coming earlier into leaf.

13. **BLACK GRAPE**—syn. Ogden's Black Grape.—Bunches smaller, but longer than those of the Black Naples. Berries large. A great improvement on the old Common Black, and deserving of cultivation on account of its not pushing so early in spring, and hence being less liable to injury from late frosts.

Propagation.—The currant, like the gooseberry, may be propagated by seed, cuttings,

suckers, and layers; also, as we have seen in particular cases, by budding and grafting. The best mode, and that which is generally practised for obtaining good plants of any particular variety, is by cuttings. These may be taken off, prepared, and planted, soon after the fruit is gathered, that is, when the young shoots are mature; but any time from the beginning of autumn till March will do; those, however, which are struck in autumn have a great advantage over those inserted in spring, inasmuch as the young roots of the former are prepared to start early in spring, and shoots are produced at the same time, the cutting becoming a plant; whilst, in the latter case, the cutting is only commencing to form roots. It will therefore be readily understood that nearly a year is gained by early autumn propagation over that performed in spring.

The cuttings should consist of well-ripened, vigorous young shoots. If taken off close to the old wood, so much the better. The end should be cut smooth, and the buds removed as far as the cutting is to be inserted in the ground. The very small buds near the base of the cutting are apt to be overlooked, but these are the most likely to produce suckers; therefore the greater care should be taken to remove them completely.

Currants ought to have a clean stem of 5 inches above the surface. If cuttings sufficiently long can be obtained, 6 inches may be allowed for insertion in the ground, 5 inches for the stem, and 3 inches for shoots to proceed from, for forming the head, thus making the whole length 14 inches. But should the cuttings be too short or weak, then it may be cut to the length of about 9 inches, or so as to have 6 inches below ground and about three buds immediately above the surface. When prepared, the cuttings should be inserted as in the case of the gooseberry. When the shoots begin to push, three should be encouraged, if the cutting is long enough to admit of these being at the proper height from the ground. If the cutting is short, the strongest and most upright shoot ought to be allowed to take the lead, and should be trained, as straight as possible, at least to 8 inches above the surface. If other shoots push, they may be allowed to grow, as their foliage will assist in forming roots; but they should be kept subordinate to the one trained upright. They will require to be cut off close in autumn, and the upright one shortened back so that the third bud below

the cut shall be 5 inches above the ground. The plants should be fit for planting out in autumn, but if not strong, they had better remain another year.

Soil and Situation.—A deep, rich, tender soil is best adapted for the currant; and in a situation open to the sun, they acquire the richest flavour. They are, however, frequently planted against north aspect walls, on which they succeed with certainty, when other kinds of fruit trees often fail. Deprived of the sun's rays from six in the morning to six at night, the fruit cannot be expected to become so sugary as that on bushes exposed throughout the day to the influence of the solar rays; yet on a north aspect, when currants are properly managed, it attains a good size and acquires a fine colour. The fruit ornaments the wall by its brilliant contrast of white and red, presuming that both sorts are planted with that view; it can also be kept in good condition on the plants, and thus afford a late supply.

The soil should be prepared as for the gooseberry; and, as with it, the planting is best performed in autumn. The distance apart, when planted in quarters, should be 5 feet each way, or even 6 feet, if the soil is very rich.

Pruning and Training.—Plants consisting of a clean stem of 5 inches, and having three shoots, should, when transplanted, have these shortened back to about 4 inches, and to a bud pointing upwards. In the following spring two shoots should be encouraged from each of the shoots so cut back, and thus, in autumn, the plant will consist of six shoots. These should all be cut back at the winter pruning, so as to leave them from 4 to 6 inches long, observing always to cut to an outward bud. To about this length the terminal shoots of the six branches should be cut at every winter pruning; and, when they have nearly attained the intended height, which need not exceed 3 feet, the terminals should be shortened every autumn to within two or three buds from their origin. In soil that is very rich, and likewise naturally favourable to the growth of the currant, the plants may be allowed to grow to the height of 4 or 5 feet, and, in that case, nine or even twelve branches may be allowed. In the latter case it would be well to have the branches trained round a hoop placed in the centre, so as to extend the branches at equal distances from each other, and more widely than would otherwise be the case. Having explained the manner by which the three

primary shoots are shortened so as to produce two shoots each, and which give rise to the six branches of which the head should generally consist, and having followed up the annual pruning of the terminal shoots of these branches, we shall now direct attention to their laterals. These should be cut back, at each winter pruning, to within $\frac{1}{2}$ inch of their bases. Some good growers for the London market cut even closer than this, or almost to the old wood. The base of the shoot consists of nearly solid wood, but farther from the base the shoots are pithy, and by exposure to the air, the pith wastes, leaving the shoot hollow below the cut, and it usually dies back. It is therefore better to cut back nearly close to the old wood, or to the origin of the shoots, in order that the buds, whether for young wood or for fruit, may have a solid basis.

As heavy crops of fruit could not be produced without plenty of nourishment, which could only be supplied from abundance of fresh roots, and as the formation of these requires a considerable amount of foliage, young shoots must be allowed to grow for this purpose, and also for producing a sufficient thickness of layers of alburnum along the branches and stems; for when these are meagre, the fruit cannot be large. It is, nevertheless, wrong to allow too much crowding of young shoots in summer. When this is likely to be the case, they should be moderately thinned early in summer, by removing some of the weakest shoots, or any that cross each other. Besides this, the tops of the strongest shoots may be cut off in June, taking care, however, that no extensive privation of foliage takes place at any one time.

Currants are trained in some gardens with a single upright stem, and when well managed in this way the plants have a very good effect. They bear well; and there is an advantage as regards the fruit being kept free from earth, by which those grown as dwarfs are frequently injured after heavy rains. When grown as standards, the principal aim should be, in the first place, to grow the stem as straight and as strong as possible. It is necessary to keep the leading stem trained to a rod or stake. Shoots must be allowed to grow along the stem; and if the latter is intended to be ultimately naked, like the stem of a tree-rose, the lower shoots and spurs should be gradually taken off below as others are produced above.

When intended to be trained against a wall

or espalier, currants should be planted 3 feet apart, and one strong upright shoot encouraged for a stem. It is essential that the plants should be well established before the formation of the primary branches is attempted; therefore, if the plants are not strong and well rooted when planted, it is better to merely shorten the shoot a little, and allow the plant to grow at freedom till the following autumn, and then cut down the upright to 3 inches from the ground. Train one shoot, the strongest, of course, upright, cut it back in autumn to 6 inches from the ground, and in the following summer, from the base of the last year's shoot, train one young shoot horizontally to the right, and another to the left. From these horizontals four upright shoots should be trained, at the distance of 9 inches from each other. These perpendicular shoots ought to be allowed to grow at full length, and should be shortened back in autumn to 6 or 8 inches. A leader from each must be trained upright every summer, and shortened to the above height every autumn; the laterals from the upright branches should be cut very closely, as directed for the laterals of the branches grown in the open ground.

Other Culture.—The soil should every year be drawn from around the trees with a hoe, and buried in the middle of the intervals, for which purpose a spade is the best; but in stirring the ground near the trees, a fork should be employed. Plenty of manure should be given. Manure water increases the size of the fruit, but does not improve the flavour.

Gathering the Fruit.—This should not be done when the fruit is wet, and, if the currants are intended for preserving, not immediately after a wet period, for they will be less watery if several days are allowed to elapse. It may not, however, be advisable to delay so long in wet seasons, for when dry days are rare it is necessary to take advantage of them.

Insects.—The currant, like the gooseberry, is often entirely defoliated by the destructive caterpillars of *Abraxas grossulariata*, *Phalaena Vauaria*, and *Nematus trimaculatus*, or *N. Ribesii*, the means employed for the destruction of which have already been detailed.

The currant sphinx (*Egeria tipuliformis*) deposits its eggs in the crevices of the bark about the end of May or in June, and, when hatched, the larva penetrates into the centre of the branches and consumes the pith, forming

a long passage downwards. The presence of the insect is indicated by the withering of the leaves of the branches attacked; as soon as this is observed, a branch presenting that appearance should be cut off and split up, and if, on examination, the caterpillar is discovered, all portions affected in a similar manner should be removed from the bush and burned.

The caterpillars of *Lampronia capitella* likewise prove injurious, by feeding upon the interior of the shoots in spring, causing them to droop, and the foliage to wither. All that can be done is to prevent the repetition of the mischief by cutting off and burning the parts affected.

Aphides are frequently found in summer, in vast numbers, at the extremities of the shoots. They may be destroyed by the usual methods, or by cutting off and burning the parts infested.

THE RASPBERRY (*Rubus Idæus*, L.—*Icosandria Polygynia*, L.; *Rosaceæ*, D. C.; *Rosaceæ*, Lind.) is a deciduous shrub, with perennial roots and a biennial stem, a native of Britain and most of the temperate parts of Europe. The fruit, being possessed of a fine aroma, is largely employed in tarts, jams, and similar preparations, as well as for the dessert. It is likewise used for making a delicious ice, raspberry vinegar, raspberry brandy, and raspberry wine.

Varieties.—These are numerous, the plant reproducing itself freely from seed with more or less variation. The following is a selection of the best:—

1. **RED ANTWERP**—syn. Burley, Knevett's Antwerp, Late-bearing Antwerp, Framboisier rouge à gros fruit.—*Canes* strong and long, yellowish green, slightly glaucous, occasionally tinged with purple, covered with dark brown bristles, especially towards the base. *Fruit* large, conical, dull red, sweet, and rich in flavour.

It bears carriage well, and is therefore much cultivated by the market gardeners. A second crop is sometimes borne in autumn, but the fruit produced is both scanty and small. This was the first improvement on the wild raspberry of the woods, and is still surpassed by none.

2. **BARNET**—syn. Cornwall's Prolific, Cornwall's Red, Cornwall's Seedling, Large Red, Lord Exmouth.—*Canes* long, yellowish green, frequently tinged with purple, much inclined to branch, covered with long slender prickles

of a reddish colour. *Fruit* large, globular, inclining to conical, of a bright purplish red, and of excellent flavour.

It ripens early, but does not bear carriage well; it is therefore only grown in private gardens. The plant is a very abundant bearer.

3. **RIVERS'S LARGE-FRUITED MONTHLY**.—*Canes* moderately tall, very hispid, with reddish prickles. *Fruit* tolerably large, roundish or obtusely conical, of a deep purplish red, in the second crop of a brighter red.

It ripens about the usual time, and again during autumn till frost.

4. **YELLOW ANTWERP**—syn. White Antwerp, Double-bearing Yellow.—*Canes* with numerous small prickles. *Fruit* middle-sized, ovate, pale yellow, rich, and sweet.

A good bearer, but not so strong-growing as the Red Antwerp.

5. **COX'S HONEY**.—*Canes* strong, hispid. *Fruit* produced in succession, and in clusters along the stem. It resembles that of the Yellow Antwerp, being very sweet and rich.

Propagation.—The raspberry is propagated by seeds, and occasionally by cuttings, but the usual mode is by suckers or offsets.

The seeds should be taken from perfectly ripe fruit, washed from the pulp, and then dried moderately, in order to prevent mouldiness. They may then be sown in rich sandy soil, or in pans, in sandy peat and well-decomposed leaf-mould. They will vegetate in the following spring, and in autumn they will be fit for transplanting into nursery rows, the first shoot being then shortened to a few eyes.

In propagating by suckers or offsets, care should be taken to injure as little as possible the plants from which they are separated. The best time for removal, so as to be least injurious to the old stools, is October, which is likewise the best time for making the plantation. Although this may be done any time when the weather is favourable during winter, or early in spring, yet it is not well to disturb the roots by taking off suckers late in spring, or after vegetation has commenced. Root-suckers are often thrown up at a considerable distance from the plant, and can be removed without materially affecting it; but frequently the suckers come out almost like offsets. When this is the case, they ought to be detached with a sharp suckering iron, and, at the same time, care should be taken not to injure the bud or buds which will be found on the part of the root just below ground, at the base of

the shoots made in the course of the enurrent season; for these buds give rise to the shoots which become the canes for bearing in the following year.

Propagation by cuttings is not a sure method, and is seldom resorted to, as the preceding mode affords so much facility; but any particular sort may be more rapidly increased by both cuttings and suckers than by suckers alone. The cuttings should be inserted in light, rich, rather moist soil, and in a somewhat shaded situation, at least one not exposed to the direct rays of the sun in the hottest part of the day.

Soil and Situation.—The raspberry succeeds in any rich garden soil that is not too stiff, but prefers one that is very rich and rather moist. It grows exceedingly well in sandy alluvial ground, also in peat and soils that are mixed with peat; but those which are heavy and compact, becoming hard in dry weather, do not suit it. In all cases, abundance of decomposed manure should be supplied when the ground is trenched before planting, and afterwards every autumn, as a top-dressing. The ground should be trenched at least 2 feet deep, and if to the depth of 3 feet, so much the better. Plenty of manure must be introduced, especially about 1 foot below the surface, for the roots near the latter can be fed by the annual manuring.

Planting.—Raspberries are usually planted in rows, and their bearing shoots tied to stakes. In this way, the distance allowed between the rows may be 5 feet, and that between the plants in the row 3 feet. In very rich soil, 6 feet between the rows, and 3 or 4 feet between the plants in the row, would be preferable distances; or the rows may be 8 feet apart, in which case, certain kitchen garden crops may be grown between; but if so, care should be taken that the soil be kept well manured and always sufficiently moist.

Raspberries are sometimes planted, for arched training, in rows 4 feet asunder, and the same distance between the plants in the row. When planted to be trained against an espalier, the plants may be 2 feet apart. Mr. Whiting states (*Gardeners' Chronicle*, 1849, p. 149) that, in poor soil, he finds planting 1 foot apart, in 5 feet rows, and leaving one, or occasionally two canes to each root, is preferable to planting at greater distances, and allowing three or four canes to each root.

Mode of Bearing.—The raspberry sends up

shoots from which the leaves drop in autumn, and, from the buds on these shoots, or canes as they are called by some, branchlets push in spring, on which fruit is produced in the course of the summer, and sometimes till autumn. The branchlets diverge in all directions from the shoots from which they spring, so that in the natural state they cannot be overerowed. Whilst these are bearing the fruit, young shoots arise from the main stock or base of the stem, and suckers frequently spring from the roots, at a distance from the plant. These bear in the following season, forming a succession to those which are bearing, and which die back to the ground before winter.

Pruning and Training.—When the plants are intended to be trained to stakes in the usual way, the pruning and training are very simple. We shall commence with a new plantation. One, two, or three canes may be planted for the purpose of being tied to a single stake. If two are planted, they may be 6 inches apart, and in the direction of the row. If three, they may be at the same distance from each other, and placed so as to form an equilateral triangle, in the centre of which the stake may be inserted. Stakes, however, will not be necessary in the first season; for the canes, when planted, should be cut down to within 6 inches or 1 foot from the ground, especially if they are weak; or, if strong, and fruit be desired the first season, they should be shortened more than the bearing shoots of an established plantation, so that, in either case, staking will not be necessary. The object of cutting back the year-old canes is to invigorate the young shoots. When these push, three, four, or five of the strongest of them should be encouraged; the others ought to be rubbed off, or destroyed by means of the suckering iron. Towards autumn, stakes must be prepared. Their lower end should be tapered to a sharp point, but without leaving angles on the taper, for when smooth, they can be introduced between the roots without breaking them. In October or November the plantation should be pruned, in order that the ground may be manured and forked over. Some think that the canes are injured by frost and rain when pruned before winter. Having much pith, injury from such causes may take place for some distance below the cut, or as far as the first joint. The plant is not susceptible of injury from frost, except

so far as the pith may get too much soaked with wet, which will be only a little way, especially if the canes are cut slanting.

In proceeding to prune, the two-year-old canes, now dead, should, in the first place, be cleared away, and three or four of the strongest young canes ought to be selected for bearing in the following season. They should be shortened where they exhibit signs of weakness and begin to twist or bend. If there are more canes than the number considered proper for being tied up for bearing, they should also be cut away. After hoeing away the surface soil, and clearing all weeds from the base of the stem, the stakes should be driven in correctly in line, and their tops cut to a regular height. The canes should then be tied to the stakes with osier twigs, or with the golden willow, than which nothing is better for the purpose, if it can be had, and if not, tar-twine may be substituted. This operation completes the first year's pruning and training. Objections have been made to the above mode of training to stakes, on account of the canes being brought too closely together, but it must be recollected that the canes do not require light; the buds of course do, but when pushing, they are not shaded, and the shoots from them extend outwards, so that the longer they grow the more space there is for the foliage. There is, therefore, less danger of the fruit-bearing branchlets crowding each other than there is of the interference of the young shoots which spring from the root for succession. In the second season the tied-up canes will require no further attention. Lateral shoots will push from them; and these, as already remarked, bear the fruit. At the same time, shoots for succession spring up, and frequently in too great abundance. When such is the case, they must be thinned out more or less, as in the preceding season; only, as the plants are now established, from four to six shoots may be allowed to grow. In autumn, three, or if strong enough, four, from each stool should be pruned and tied as already directed.

When raspberries are intended to be trained to a rail, the latter may be constructed of stakes and strips of deal about 1 inch thick. The stakes should be driven in line at every 5 or 6 feet and the strips of deal nailed along their tops, which may be 3 or 4 feet from the ground, according to the length of the canes; and other strips may run along at 18 inches

or 2 feet from the surface, or a wire may be stretched at that height. To these horizontals the canes should be trained, so as to leave room for a succession shoot between each. The weak points of the bearing canes ought to be cut off, and superfluous shoots removed at an early stage of their growth. Dr. Neill, in his *Fruit and Kitchen Garden*, suggests a modification of training to a rail, which deserves to be noticed. He says, "Perhaps the best support is obtained by fastening the points of the shoots to a slight horizontal rail or bar, about 4 feet high, and placed $1\frac{1}{2}$ foot on the south side of the rows. By this means the bearing shoots are deflected from the perpendicular to the sunny side of the row, and are not shaded by the annual wood."

Raspberries are sometimes trained by arching, and for this mode they are planted about 4 feet apart in the rows. A stake is driven in midway between the plants; half the canes belonging to one plant and half of those of the adjoining plant are bent towards each other, and their ends are tied together so as to form an arch, which is secured to the stake in the centre.

There are some varieties of raspberry, such as Rivers' Large Fruited Monthly, which naturally produce fruit late in autumn; but other varieties may be induced to do so by cutting down the canes to within 1 foot of the ground. The shoots which push from these shortened canes grow vigorously, and usually produce fruit late in the season. Another mode is to shorten the canes rather more than usual; then, when the laterals push, and before they flower, they are cut back nearly to their bases, and from these fresh shoots are produced which fruit late in the season. In order to obtain very large fruit, so far as this depends on pruning and training, few bearing shoots should be left to each plant, or, in particular cases, some plants, or a row or two, may be sacrificed by permitting no suckers to grow. Of course, no fruit can be obtained in the following season from plants so treated, the formation of shoots for future bearing being prevented, but in consequence of this the fruiting canes will be better nourished and the fruit larger.

Other Culture.—This consists in keeping the surface stirred and free of weeds. Manure should be applied in autumn, and ought to be worked into the surface of the soil with a fork, without disturbing the soil to the depth

of more than 4 or 5 inches, but to this depth it should be regularly turned over every year. If the operation is neglected one year, it cannot afterwards be performed without destroying the roots which have formed near the surface in the interval, and, consequently, ruining the plantation. Suckers not required for future bearing, or for a new plantation, should never be allowed to appear much above the surface; and in forking over the ground, they should be traced and eradicated as near to their origin as it is possible to do without injuring the root from which they spring.

Diseases and Insects.—The raspberry, when planted in a suitable soil and situation, and otherwise properly managed, is not liable to be attacked by diseases; and it rarely suffers any material injury from insects.

The grub of the raspberry-bud (*Tinea corticella*, L.) occasionally proves injurious to the crop by consuming the interior of the flower-buds and the footstalk of the fruit, causing them to wither up and die. About the end of May the caterpillar enters into the pupa state, and in a fortnight reappears as a moth, which deposits its eggs on the stems, but whether on the young or old wood is not known. The larvæ are produced early in August, and feed upon the leaves till winter, when they conceal themselves, and in spring again attack the young buds. The crop from the buds attacked being lost at any rate, all that can be done is to prevent the recurrence of the evil, by pinching the flower-buds in which the presence of the insect is indicated by their withered appearance.

The raspberry-leaf miner (*Fenusa pumila*) occasionally injures the plants by consuming the cellular tissue contained between the upper and lower surfaces of the leaf, which, when thus attacked, presents a blotched appearance, by which the presence of the caterpillar is made apparent. Collecting and burning the leaves affected is the most effectual remedy.

The grub of another insect (*Byturus tomentosus*) is very frequently found in the fruit, which it does not attack till nearly ripe. No remedy is known.

THE STRAWBERRY (*Fragaria*, L.—Icosandria Polygynia, L.; Rosaceæ, D.C.; Rosaceæ, Lind.)—Several species, indigenous to various parts of the world, have given rise to numerous varieties. From *Fragaria vesca*, *elatior*, and *collina*, natives of Britain and other parts of Europe, have been derived respectively the

Wood and Alpine, the Hautbois, and the Green. The *Fragaria grandiflora*, a native of Surinam, and *Fragaria chilensis*, have produced the numerous varieties of pine strawberries. *Fragaria virginiana* is considered the original type of the scarlet strawberries. The varieties of strawberries were first classified and accurately described by Mr. Barnet, in the sixth volume of the *Transactions of the Horticultural Society*; but as many of the sorts cross very readily, especially the scarlets, pines, and chilis, numerous varieties have since been obtained.

CLASS I.—SCARLET.

1. **AMERICAN SCARLET**—syn. Black American, New American Scarlet, New Roseberry, Thompson's Roseberry.—Petioles tall, strong, erect, hairy. Leaflets large, oval, with coarse rounded serratures, of a shining, dark green colour. Calyx reflexed. *Fruit* middle-sized, conical and pointed, with a neck, of a deep red colour. Flesh dark scarlet, firm, rich, and sweet. It ripens in the beginning or middle of July, is an abundant bearer, and valuable for its lateness and fine flavour. The plant requires plenty of room.

2. **CUTHILL'S BLACK PRINCE**—syn. Malcolm's Aberdeen Seedling.—Petioles tall, slender, spreading, very slightly hairy. Leaflets small, roundish oval, with moderately deep, sharp serratures, of a somewhat glaucous green. Petals assuming a violet red tinge when they begin to fade. Calyx small, spreading, or somewhat reflexed. *Fruit* middle-sized, roundish or ovate, with a neck, of a shining, very dark red, or even of blackish hue when perfectly ripe. Flesh dark red, juicy, tolerably rich, and well flavoured. It ripens about the middle of June, or somewhat earlier than Keens' Seedling, and is an abundant bearer. Its principal merit is its earliness.

3. **GROVE END SCARLET**—syn. Atkinson's Scarlet, Wilmot's Early Scarlet.—Petioles tall, weak, nearly smooth. Leaflets small, oblong, deeply and sharply serrated, of a light green colour. Calyx large, reflexed. *Fruit* large, depressed spherical, of a bright vermilion colour. Flesh pale red, firm, of an agreeable, somewhat acid flavour. It ripens in the middle or end of June, is an abundant bearer, and forces well.

4. **OLD SCARLET**—syn. Scarlet, Écarlate, Early Scarlet, Virginian, De Virginie, Scarlet Virginian, Écarlate de Virginie, Orange or Irish of the Dutch.—Petioles tall, erect, very slightly hairy. Leaflets large, oblong, coarsely and sharply serrated, pale green. Calyx small, spreading. *Fruit* middle-sized, slightly hairy, of a bright scarlet colour. Seeds deeply embedded. Flesh firm, pale scarlet, acid, and of good flavour. It ripens in the middle or end of June, but is rather a shy bearer. It is chiefly valuable on account of its earliness and fine colour, and is largely used for preserving, and in ices.

5. **ROSEBERRY**—syn. Aberdeen, Aberdeen Seedling, Brickley Scarlet, Prolific Pine, Scotch Scarlet.—Petioles short, somewhat erect, slightly hairy. Leaflets very small, oval, pointed at both ends, finely and deeply serrated, glaucous green. Calyx large, spreading. *Fruit* large, conical, with a short neck, sometimes cockscomb shaped, dark red, hairy. Seeds deeply imbedded. Flesh

firm, pale scarlet, of a very agreeable flavour. It ripens in the end of June or beginning of July, and continues in long succession. A very abundant bearer, and forces well.

CLASS II.—BLACK.

6. DOWNTON.—Petioles very long, spreading, hairy. Leaflets large, elliptical, coarsely serrated, of a shining light green colour. Calyx large, generally incurved, sometimes reflexed. *Fruit* large, ovate, sometimes of a cockscomb shape, with a neck, dark purplish scarlet next the sun, paler on the opposite side. Flesh firm, scarlet, juicy, very rich and excellent. It ripens in the beginning or middle of July, is very productive, and forces well.

CLASS III.—PINES.

7. ELTON—syn. Elton Seedling.—Petioles short, upright, very hairy. Leaflets middle-sized, obtusely serrated, of a deep green colour. Calyx middle-sized, incurved, sometimes partially reflexed. *Fruit* large, ovate, frequently cockscomb-shaped, dark red. Flesh firm, juicy, briskly acid, rich. It ripens in the middle or end of July, and is a very abundant bearer. It is chiefly valuable on account of its lateness and productiveness, coming in after the Old Pine and Downton, and ripening in long succession. The fruit is also particularly well adapted for preserving whole.

8. KEENS' SEEDLING—syn. Keens' New Pine, Keens' Black Pine, Murphy's Child.—Petioles tall, slightly hairy. Leaflets very large, roundish, coarsely serrated, smooth, shining dark green. Calyx of moderate size, hairy, incurved. *Fruit* very large, roundish, sometimes cockscomb-shaped, slightly hairy, dark purplish scarlet next the sun, paler on the shaded side. Flesh moderately firm, scarlet, of a rich and agreeable flavour. It ripens in the middle or end of June, and is a very abundant bearer, on which account, as well as its large size and excellent quality, it is extensively grown throughout the country, and particularly by the market-gardeners.

9. MYATT'S BRITISH QUEEN.—Petioles tall, erect, hairy. Leaflets large, oval, coarsely serrated, of a light green colour. Calyx large, somewhat spreading. *Fruit* very large, ovate, sometimes cockscomb-shaped, light scarlet. Flesh moderately firm, pale red, juicy, rich, and excellent. It ripens in the end of June, succeeding Keens' Seedling, is an abundant bearer, and also forces well.

10. MYATT'S ELEANOR.—Petioles rather dwarf, spreading, hairy. Leaflets middle-sized, roundish oval, obtusely serrated, deep green. Calyx middle-sized, spreading. *Fruit* large, ovate or oblong, generally a little flattened on the sides, dark red. Flesh reddish, juicy, but with much acidity. It ripens in the beginning or middle of July, or rather earlier than the Elton, and is an abundant bearer, continuing in long succession. It is extensively cultivated for the London markets.

11. MYATT'S MAMMOTH.—Petioles dwarf, spreading, very hairy. Leaflets small, nearly round, with wide, obtuse serratures, deep green. Calyx small, reflexed. *Fruit* very large, roundish oblong or sometimes cockscomb-shaped, with a glossy neck, of a bright red colour. Flesh reddish, paler towards the core, coarse, rather acid, and of indifferent flavour. It ripens in the beginning of July, or soon after the British Queen, and is but a moderate bearer. The variety is only worthy of cultivation on account of the large size of the fruit. The plants

require to be kept free from runners, otherwise the berries do not ripen perfectly.

12. OLD PINE—syn. Carolina, Black Carolina, Common Carolina, Large Carolina, Old Carolina, Carolina Pine, Black Pine, Blood Pine, Scarlet Pine, Old Scarlet Pine, Borsdorf.—Petioles tall, upright, hairy. Leaflets small, roundish obovate, obtusely serrated, of a dark green colour. Calyx large, spreading. *Fruit* large, ovate, with a neck, sometimes of a cockscomb shape, slightly hairy, bright scarlet. Flesh pale scarlet, solid, rich, juicy, and excellent. It ripens in the end of June or beginning of July, and is a good bearer, preferring a cool situation and a rather stiff soil. It is one of the very best sorts.

13. ROUND WHITE CAROLINA—syn. Carolina, White Carolina, Conical White Carolina, Chili, White Chili, Large White Chili, Large Pale Chili, Cone, Globe, Large White, Large Blush Pine, White Pine, White Bath.—Petioles very long, slightly hairy. Leaflets large, nearly oval, coarsely and obtusely serrated, of a shining dark green. Calyx large, incurved. *Fruit* large, roundish, or irregularly ovate, white, sometimes reddish next the sun. Seeds deeply embedded. Flesh soft, white, pleasant, but not of high flavour. It ripens in the end of June or beginning of July, and is a good bearer. It is only cultivated on account of its fruit contrasting well with strawberries of a more brilliant colour.

14. SWAINSTONE SEEDLING—syn. Royal Pine.—Petioles moderately tall, spreading, hairy. Leaflets broad oval, coarsely serrated, of a rather light green. Calyx middle sized, spreading or reflexed. *Fruit* large, roundish or somewhat conical, pale scarlet. Flesh juicy, rich, and agreeable. It ripens in the end of June, and is very productive, bearing sometimes a second crop in autumn.

15. VICOMTESSE HERICART DE THURY—syn. Duchesse de Trévis.—Petioles moderately tall, spreading, very hairy. Leaflets large, broad oval, with large obtuse serratures, yellowish-green. Calyx rather small, incurved. *Fruit* middle-sized, ovate, of a deep red colour. Flesh pale red, juicy, brisk, and rich. It ripens about the middle or end of June, and is an abundant bearer.

CLASS IV.—HAUTOIS.

16. LARGE FLAT HAUTOIS—syn. Bath, Formosa, Lowder's, Salter's, Weymouth, White.—Petioles short, upright, hairy. Leaflets large, irregularly ovate, obtusely serrated, of a yellowish-green colour. Calyx close to the base of the fruit, reflexed. *Fruit* large for this class, roundish, depressed, light red, pale on the under side. Flesh greenish, without core, juicy, and rich. It ripens in the end of June and beginning of July, and is a very abundant bearer.

17. PROLIFIC HAUTOIS—syn. Conical, Double Bearing, Dwarf, Hermaphrodite, Musk, Regent's, Sacombe, Sir Joseph Banks, Spring Grove, Capron Royal, Capron Hermaphrodite.—Petioles tall, upright, hairy. Leaflets middle-sized, irregularly oblong, with strong coarse serratures, light green. Calyx small, reflexed. Stamens long, remaining round the base of the fruit even after the latter is ripe. *Fruit* large for this class, conical, dark brownish purple next the sun, paler on the shaded side. Flesh solid, but of soft consistence, greenish, juicy, highly perfumed, and of excellent flavour. It ripens in the end of June and beginning of July, and sometimes produces a second crop, ripening in October or later. It is an abundant bearer, and, on the whole, the best of its class.

CLASS V.—GREEN.

18. GREEN STRAWBERRY—syn. Green Alpine, Green Wood, Green Pine, Powdered Pine, Vert d'Angleterre, Fraisier Vert.—Petioles dwarf, erect, slender, hairy. Leaflets small, oval, finely and sharply serrated, deep green. Calyx rather large, incurved, imbedded in the fruit. *Fruit* small, roundish or depressed globular, greenish white, tinged with red next the sun. Flesh solid, greenish, very juicy, of a peculiar and very agreeable pine-apple flavour. It ripens in the middle of July, and is a very abundant bearer. It is chiefly cultivated on account of its peculiar flavour, and for the variety which it affords when mixed with other sorts of brighter colours. Owing to the weakness of the scapes, the fruit lies close to the ground, and is hid amongst the leaves.

CLASS VI.—ALPINE.

19. RED ALPINE—syn. Prolific Alpine, Scarlet Alpine, Des Alpes à Fruit Rouge, Des Alpes de Tous les Mois à Fruit Rouge, Des Alpes de Deux Saisons à Fruit Rouge, Des Alpes de Quatre Saisons à Fruit Rouge, Alpine Rouge.—Petioles dwarf, slender, hairy, erect. Leaflets small, oval, sharply serrated, the tips of the serratures of a reddish colour. Calyx small, reflexed. *Fruit* small, conical, bright red, dark brownish red next the sun. Seeds small, numerous, prominent. Flesh solid, pale red next the outside, white towards the centre, juicy, rich, and subacid. It ripens from June to November, and is a most abundant bearer.

20. WHITE ALPINE—syn. Des Alpes à Fruit Blanc, Des Alpes de Tous les Mois à Fruit Blanc, Des Alpes de Deux Saisons à Fruit Blanc, Des Alpes de Quatre Saisons à Fruit Blanc, Alpine Blanc.—The leaves of this are similar to those of the Red Alpine, except that they are of a somewhat paler green, and the tips of the serratures are white. The fruit is white and scarcely so acid as the Red Alpine, which it resembles in every other respect.

Propagation.—The strawberry is propagated by seeds, division of the plant, and by runners. The Alpine varieties are always best raised from seeds; the other kinds are continued true to their variety by runners.

The seeds of the Alpine varieties should be taken from the finest fruit ripened in the end of June or in July. To obtain the seeds, the fruit may either be bruised on sheets of brown paper and dried by exposure to the sun and air, or it may be bruised by hand in water, and the seeds washed, those which float being rejected. If intended to be kept till spring, the seed should be well dried; but if not, it ought to be merely surface-dried and immediately sown, either in a sheltered part in the open ground, or in pots. If in the open ground, the soil should be a very fine, rich mould, mixed with peat, well decomposed dung, or leaf-mould. The ground, if dry, should be watered; and, when in working condition, the surface having been made

smooth and even, the handle of the rake or any straight round rod, should be laid across the bed at every 6 inches, moderately pressed, and, in the impressions so made, the seeds should be thinly sown, then pressed by again applying the rod; and they ought afterwards to be very slightly covered by sifting over them a little decayed leaf-mould, or old decomposed cow-dung. When necessary, the bed should be watered from a pot with a fine rose. Previous to watering, some cover the surface thinly with chopped moss. The plants should appear in less than a month, and may be transplanted to where they are to remain for bearing, as soon as they have made 4 or 5 leaves. The plants may, however, be much more quickly brought forward under glass, where that is at command. The seeds may be sown in pots or in pans, and kept in gentle heat. Care should be taken that the soil do not become too dry, to prevent which the pots may be covered with glass rendered opaque, or with slates, till the seeds begin to germinate. The plants should be pricked out in fine soil laid to the depth of 6 or 8 inches on a slight hot-bed; and in June, they may be transferred to the open ground for bearing partially late in the autumn, and a full crop in the following season. The runners should be kept cut off the seedling plants, unless some are required to extend the plantation, and, in that case, it is a good plan to employ the first plant made by the runner from the seedling.

Runners are usually produced in great abundance from most varieties; but a sort called the Bush Alpine has not this property, and a few others, not worthy of cultivation, emit them but sparingly. The point of a runner is furnished with a bud, and when the runner has extended to some distance from the stem, the bud unfolds, and soon afterwards roots are emitted from its base. If in contact with moist, permeable soil, these soon fix themselves, and a young plant is established. This is fed from the mother plant by means of its own roots, another runner proceeds from it, and, in a similar manner to the first, another young plant is formed, and so on. The runner is fed entirely by the mother plant in the first place, and so is the young plant, till such time as it is enabled to strike root, and, if circumstances do not admit of this being readily effected, not only the runner and first plant, but also the

series of runners which are to be produced in continuation, together with the plants which form upon them at intervals, must be also fed by the parent plant. Now, it is evident that, if the runners be stopped after the first plant is formed, one plant will be better nourished than if a number had to be supplied from the same source. Again, the earlier the young plant can be rooted, the stronger and more substantial it will become, from having the advantage of exposure to light whilst the days are long. From what has been stated, it will readily be admitted that, in order to have good plants, means should be employed to facilitate the early production of runners, and to permit only one to grow from each runner, provided that that will afford a sufficient number of plants. The first proceeding is to encourage the plants to emit runners. This they do readily in moist warm weather, but very slowly, if at all, when the weather is very dry, unless the plants are well watered. Care should therefore be taken to keep the ground moist, so that the growth of the old plants may not be checked from dryness at the root. The runner, also, makes greater progress along a moist surface than it does along one that is dry. On a large scale, the runners for propagation are allowed to root in soil adjoining the plants; it should, therefore, be dug or forked over and made fine for the roots to strike into, which they will soon do if it is kept moist, and they are closely in contact with it; and this, in many cases, can be easily done by a bit of stone placed on the runner. As soon as the young plant has developed a few leaves, the runner from it should be stopped. On a small scale, and to obtain plants for forcing, 3-inch pots can be very advantageously employed. These are filled with good rich soil, and it is well to sink them in the ground, nearly to the brim. As soon as the bud at the first joint of the runner has developed a few leaves, it is pressed closely upon the soil in the pot, and kept in contact with it either by means of a small hooked peg, or a small stone.

The strawberry may be propagated, in cases of emergency, or in the absence of runners, by division of the plant; but it is neither a sure nor an expeditious method, for the plants are apt to fail, and, if they do take root, they grow but slowly, compared with young plants from runners, and are apt to die off in winter. The best time to divide the roots is early in

spring, before the young leaves expand, or in August, whilst there is heat in the ground to encourage the growth of roots before winter. If done in August, the old leaves should be mostly taken off. The plants must be protected from the direct rays of the sun till they have struck root, and the ground should be kept moderately moist. They ought to be mulched, before winter, with leaves, or any kind of litter that will protect them, to a considerable extent, from severe frost. The Bush Alpine, and some other sorts cultivated by the French, can only be propagated by division and by seeds.

Soil and Situation.—The strawberry will grow in any good garden soil. The scarlet kinds prefer a rich sandy loam; but the pine varieties, and especially the Old Pine, succeed well in rather strong loam, provided it is enriched by manure and kept moist. Tenacious soils do not suit the strawberry, unless ameliorated by such means as have been pointed out in the chapter on soils. Ground that is apt to get very dry from the effects of only ten days or a fortnight's drought is not suitable, on account of the enormous quantity of water that will be necessary; and if once the plants begin to flag for want of moisture, the crop will be all but lost. A soil that is naturally somewhat moist, but not too wet, answers well; and, where the land has admitted of irrigation, we have seen heavy crops produced every year.

If the nature of the ground permit, it should be trenched to the depth of at least 2 or 3 feet, supplying, at the same time, plenty of manure, most of which should lie at 1 foot from the surface. If the surface consists of old garden soil that has been long manured, and if there is any yellow loam below, it will be very desirable, in trenching, to turn up some of the latter to the top, and then, after trenching, to spread a layer of dung on the surface, mixing it well with the fresh loam in digging it in. The loam will tend to prevent the plants from growing too much to leaf, instead of forming flower-stems. For stiff soils, good peat, if at command, is very proper; and rotten leaves and leaf-mould are excellent for strawberries.

Planting.—The best time for this operation is as soon as the plants are well rooted. If the ground, on account of crops, or owing to other circumstances, cannot be got ready for planting in summer, then it should be done

early in autumn, whilst the ground is warm enough to encourage the plants to strike good root before winter; or, if this cannot be done, the operation had better be deferred till the plants are about to start into fresh growth in spring, in February or March, according to the season and state of the weather. When it is foreseen that the plantation cannot be made in autumn, it is a very good plan to take up the runners, when well rooted, and plant them at 6 inches apart each way, in 4 feet beds, with 1 foot alleys between them, which will afford convenient space for weeding and watering without trampling amongst the plants. In this way, 4 or 5 rods will hold sufficient for planting $\frac{1}{4}$ acre. When the ground is ready for planting, furrows should be drawn with a hoe, as if for sowing pease. The plants ought to be carefully taken up with balls, laid on a hand-barrow, and planted with a trowel. The proper distance between the rows varies according to the nature of the soil and the habit of the plant. In very rich soil, the sorts with large foliage are allowed by some as much as $2\frac{1}{2}$ feet between the rows, and 18 inches from plant to plant in the row. Mr. Keens planted in rows 2 feet apart, with an interval of 3 feet between every two rows, the plants 18 inches apart in the row. Mr. Myatt, the celebrated grower at Deptford, plants in rows 18 inches apart, and the same distance from plant to plant in the rows, but leaves a space of 30 inches for an alley between every three rows, and after the fruit is gathered in the first year, the middle row is cleared away. Mr. Lydiard, one of the best growers near Bath, plants in rows $2\frac{1}{2}$ feet apart, the plants being 2 feet from each other in the rows. According to Mr. Keens' plan, each plant has a free space of 540 square inches. By Mr. Myatt's plan, the plants in the rows next the alley have each a space of 432 inches, and those in the middle row 324 inches; but after the first year, when the middle row is done away with, each plant has a space of 594 inches. At the distances preferred by Mr. Lydiard, each plant has a space of 720 inches. In Keens' plan there are seventy-two plants to a rod, in Lydiard's fifty-four or fifty-five, in Myatt's ninety-nine in the first year, and sixty-six afterwards.

The distance allowed by Mr. Keens is very proper for general cultivation. The interval of 3 feet between every two rows admits of

space for young plants from runners, when a new plantation is required. By Mr. Myatt's plan, the ground is more fully occupied during the first season, when the plants are comparatively small, than is the case when the other distances are adopted. Mr. Lydiard's plants have the greatest space; but they grow very large, in consequence of the encouragement given to the production of young foliage by the removal of the old, after the fruit is gathered. Scarlets may be planted in rows 2 feet apart, the plants being 15 inches apart in the rows. In some cases, when the young plants from runners are early rooted and well grown, they may be planted doubly close for bearing in the following season, and after the fruit is gathered, every other plant can be removed, care being taken in doing so not to injure the roots of the plants intended to be left. In planting, the roots with the ball of earth should be placed as deep as they can be without covering the heart of the plant. Water must be plentifully given at first, but afterwards sparingly, until the plants have taken root.

Cultivation.—After the plantation has been completed, the ground should be kept clear of weeds, and the surface stirred. Runners should not be cut off on their first appearance, otherwise a superabundance of foliage is induced; but, when the runner has formed a second joint or bud, it may be cut off near to the plant from which it springs, unless wanted for propagation. After July, all runners should be taken off shortly after they make their appearance. The late Mr. Keens used to divest his plants of runners three times in the course of the season.

With regard to cutting off the foliage, much has been said both for and against this proceeding. We believe it to be advantageous or the contrary, according to the time and manner in which the operation is performed. To mow down the foliage, young and old indiscriminately, is doubtless injurious; but the removal of the old leaves at the proper time must prove beneficial, inasmuch as more light is admitted, in consequence, to the young and active portion of the foliage. The practice is adopted by the Bath growers, so celebrated for their magnificent strawberries, some of which have measured fully 7 inches in circumference, and who, as soon as the fruit is gathered, cut off all the old leaves with a knife. This is certainly preferable to mowing

down with a scythe, for with the knife the old foliage can be removed, and the young spared. We observed, on visiting the garden of Mr. Lydiard, at Bath Easton, near Bath, in 1853, that, in consequence of this mode of proceeding, the plants had acquired, by the 11th of September, a large size from the growth of fresh foliage, which had even become robust from having all the light which the old leaves would have intercepted, had they been allowed to remain.

"These young and vigorous leaves were in a condition to elaborate sap to form equally vigorous roots for supplying abundant nourishment to the ensuing crop. After it is gathered, the knife is again immediately employed to remove all old leaves, in order to give space and light for new ones. And inasmuch as the large amount of fresh foliage, thus annually encouraged, produces a corresponding amount of new tissue, the plants are so far annually regenerated; and hence it may be concluded, that the frequent renewal of the plantations becomes less necessary."—(*Journal of Horticultural Society*, vol. ix. p. 46.)

At Bath Easton the plantations remain in bearing during six, or from that to ten years.

Mulching between the rows of strawberries, as performed by the London growers, is very advantageous in various respects. It serves to keep the ground moist and the fruit clean, as well as to afford nourishment to the plants. It consists of long dung, chiefly stable litter, and is put on in spring. The manuring principles of the mulching are washed down by the rains, or by artificial watering, and the portion next the soil becomes partially decomposed, whilst the upper part, bleached by sun and rain, serves to keep the fruit clean, and the whole has a most beneficial effect in keeping the soil moist. The mulching which Mr. Cuthill uses is horse droppings, covered with at least 1 inch thick of clean straw, laid on just when the plants are coming into flower; and by watering frequently in dry weather, the strength of the manure is washed down amongst the roots by the time the fruit is ripe, when they most want it, leaving the straw clean and sweet.

Various other materials have been employed for mulching; but, on the whole, we believe that nothing is better than the littery dung. If not washed clean by rains, or by artificial watering, before the fruit begins to change colour, a thin sprinkling of clean straw can

be then laid over the surface. Tiles have been employed, but they are apt to get much heated by the sun, and spoil the flavour of the fruit which rests upon them; and, besides this, they afford shelter to insects injurious to the crop.

From the time the blossoms begin to appear till the fruit is ripe, the ground should never be allowed to become dry. The plants, when in full foliage and active growth, evaporate a large amount of moisture in dry weather. Watering over the tops is not sufficient in hot weather. In some soils, it is necessary to flood the whole surface of the ground repeatedly, so that the water may reach the lowest roots. The leaves should never be allowed to flag, for if permitted to do so they will never perfectly resume their functions, even if afterwards supplied with abundance of moisture, and from being unable to digest it properly, the fruit will be of bad flavour. In recommending plentiful watering, it is not to be understood that water is to be given from any source without due precaution. If cold spring water has to be used, it should only be given in a somewhat limited quantity at a time, only as much in one afternoon as can be warmed in passing through the mulching. If the following day should prove hot and sunny, the mulching will again become heated, and be in condition to warm an additional supply of water in the following afternoon. Where water can be obtained from reservoirs supplied by rain, or from a running stream, such precaution will not be necessary; but from whatever source moisture is supplied, care should be taken to avoid wetting the foliage when the sun is hot.

Renewing the Plantations.—There has been much difference of opinion upon this point, some recommending the plantations to be renewed every year, others every second or third year, whilst some of the celebrated growers near Bath allow a plantation to bear for six or ten years. Much depends on the way in which the plants are managed; if they are kept free of runners and divested of the old leaves after the fruit has been gathered, the plantation may be allowed to remain longer than when these matters are neglected. If the stem of any strong growing sort be taken and the lower leaves stripped off, it will be seen that there are a number of white points ready to push, if circumstances should be favourable to their doing so. They do not

push through the coatings formed by the bases of the leaves above ground, but if the stem is buried in soil, or in a good top-dressing of rotten dung, leaf-mould, or even leaves, they will strike root, in consequence of which the plants will be greatly invigorated, and will bear well for many years. The Old Pine has been known to produce excellent crops when so treated, the plantation not having been renewed for twelve years.

A covering of leaves suits the strawberry remarkably well. Some have been known to bear good crops under a large Bigarreau cherry tree, the leaves of which were allowed to remain, as they fell, upon the plants. The strawberry will push through a considerable thickness of leaves or any light substance. A top-dressing of loam is even beneficial, if applied before the plants begin to grow in spring, for after that period they should not be disturbed either at root or top.

Digging between the rows with the spade is injurious. The sole object in doing so can only be to loosen the soil, in order that fresh roots may push more freely; but many of the roots formed in the previous season will, of course, be cut off, and they are those which contribute most to the support of the crop. The soil, however, may and should be stirred with a fork, as with proper care this can be done with very little injury to the roots, and this injury will be compensated by the great advantage which the plants generally derive from the operation.

Strawberry plants sometimes produce a great number of leaves and scapes from the same stock. When this is the case, and when it is desired to have the fruit large and fine, about four of the strongest scapes are selected to be retained, and the others, with the leaves connected with them at the base, are thinned out. It will have been observed that the lowest blossoms on the scape produce the largest, earliest, and best ripened fruit, and that, when such are ripe, those higher up are still green, whilst towards the top some of the pedicels are only bearing flowers. The fruit from these never acquires the perfection of that formed lower down. In forcing, it is found advantageous to cut or clip off these upper productions, for, when this is done, those below attain a larger size than would otherwise be the case. The same operation might be advantageously performed on plants in the open ground by persons who can afford the time to do so. At

any rate, the beneficial effects of the practice should be known, in order that amateurs and private growers may avail themselves of it.

Strawberries are occasionally grown on banks, ridges, and terraces; but we do not think it necessary to enter into details respecting these modes, for the plant will grow in almost any situation where it can be supplied with moisture and sufficient nourishment, and where, at the same time, the foliage can be exposed to light. There are, however, particular advantages to be derived from a terraced ridge formed to run east and west, for the plants on the south side ripen fruit earlier than those on the level ground, whilst those on the north side afford a later supply.

Gathering.—Strawberries should be gathered if possible when dry, but not when heated by the sun. For dessert, they ought to be gathered with the calyx and just as much of the stalk below it as is sufficient to lay hold of. Those intended for preserving are taken without the calyx.

Diseases and Insects.—There has been much said and written respecting male, female, and hermaphrodite plants, but we have never seen what could be properly designated either male or female plants. It is often the case that the flowers prove abortive, either from the effects of frost late in spring, or from an abnormal state of growth in the plants; but, in the former case, there is neither stigma nor style to be seen, only stamens, which in most plants are hardier than the female organs. Frost frequently proves injurious before the flowers expand, and, when they do so, it is with what is termed *black eyes*, the receptacle and the rudiments of the styles having been killed, and their remains appearing of that colour; but this is not natural to the plant, being purely the effect of an accident occurring to that which would otherwise become perfect. Sterility has, however, been known to pervade, with a few exceptions, a whole plantation of Hautbois, although the plants were not at all injured by frost. This would have been considered a proof of the theory of the plants being dioecious, and many, in such cases, would have taken the precaution to replace the plants with others from bearing beds. These plants were, in fact, taken from bearing beds the year previous, and planted in a rich, well-manured border, in which they started rapidly into too great luxuriance, the growth being to leaves rather than to fruit.

The plants, however, were not removed, nor were others introduced, nevertheless, the whole bore a most abundant crop in the following season, therefore they could not have been male plants; and we believe that there is no such thing as naturally distinct male and female plants in the strawberry. Abortions may occur, but they may always be referred to such causes as frost, over-luxuriance, and sudden heat with moisture.

The strawberry is frequently attacked by snails and slugs, and by the grubs of the spotted garden-gnat (*Tipula maculosa*), which cut off the flower-stalks by the ground; and the larvæ of *Hepialus lupulinus*, *Otiorynchus tenebri-cosus*, and various other insects prey upon the roots. For snails and slugs, dusting with newly slaked lime is the best remedy; and, when the plants are seriously attacked at the roots, it is generally better to form a fresh plantation than to attempt to combat the evil. The ground of the old beds should afterwards be deeply trenched, in order to bury the insects.

THE ELDER (*Sambucus nigra*, L.—Pentandria Trigynia, L.; Caprifoliaceæ, D.C.; Caprifoliaceæ, Lind.) is a low, deciduous tree, a native of Britain and other parts of Europe, as well as of the north of Africa. The berries are employed in making elder-wine, of which large quantities are consumed at Christmas, and for the production of a jelly which is said to be useful in cases of severe cold and sore throat. Elder-flower water, which is used for flavouring confectionary and as a lotion for the skin, is obtained from the flowers; and the whole tree is held in great estimation by country people for its medicinal properties. Besides the common sort with black berries, there is a variety with green, and another with yellow fruit, but these are chiefly planted for ornament. The elder is propagated with great facility, either by seeds sown in autumn or spring, or by cuttings. The latter method, being the most expeditious, is that usually adopted. The cuttings may be made any time between the end of October and the beginning of March; they should be taken off immediately below a joint, and may be 1 foot or 18 inches in length. They should be inserted to about half their length in the ground, where they soon strike root, and, in the following year, are fit for being finally planted out. If the trees are to be grown as standards, they may be planted 20 feet apart; sometimes, however, cuttings are put in 1 foot

apart, so as to form a hedge. The elder will grow luxuriantly in any good garden soil, and is not particular as to situation; but a sunny spot is desirable, where good fruit is an object. Further than removing suckers when the trees are young, and forming a regular head, no other culture is required.

THE MULBERRY (*Morus nigra*, L.—Monœcia Tetrandria, L.; Urticæ, D.C.; Moraceæ, Lind.) is a monœcious tree, a native of Persia, whence it is supposed to have been introduced into Europe by the Greeks. The fruit, which is composed of a number of grains, is oval, 1 inch or more in length, and about $\frac{3}{4}$ inch in diameter at the widest part, of a dark purple colour approaching to black, very juicy, and having a sub-acid flavour. It is occasionally eaten at the dessert, and sometimes preserved, or made into a sort of wine. A syrup is also prepared from the berries gathered before they are fully ripe, or whilst still red.

The mulberry succeeds best in a rich deep loam, rather light than otherwise, and somewhat moist. It grows well in any good garden ground; but in very dry, shallow soils, as well as in those which are heavy, cold, or wet, the fruit rarely acquires any degree of perfection, and generally drops before it is fully ripe. The tree requires a situation well sheltered from northerly winds, but open to the sun on the south. In the neighbourhood of London, and in all the warm parts of the kingdom, it succeeds perfectly well, and ripens its fruit as a standard; but in the cold parts of Scotland, and in the north of England, it requires a wall with a warm aspect.

Propagation is effected by seeds, cuttings, and layers, also by budding and grafting. The seed is separated from the fruit by bruising the latter between the hands, and washing it free from the pulp in a basin of water. The seeds should then be thoroughly dried, put in paper or canvas bags, and kept in a cool, dry place till spring. The seeds may be sown in March, in pans filled with light rich mould, placed in gentle heat, the seedlings being potted off or planted out in the course of the summer; or they may be sown out of doors, in soil of a similar description, in May. In either case there should only be a slight covering of fine mould, and frequent waterings through a fine rose ought to be given. During the winter, the young plants should be protected from severe frosts by hoops and mats, or other available means. In March they may

be taken up, shortened to one eye, and planted 1 foot apart, in rows 2 feet from each other. Propagation by seed, however, is seldom practised, as plants so raised, unless grafted, are long in coming into bearing, and frequently produce only male blossoms.

Cuttings may be made in spring or autumn, and should be taken from the upper branches of the tree in preference to the lower ones, for, when so chosen, they are said to come sooner into bearing. When made in spring, they should be taken from well-ripened shoots of the preceding year, and a joint of two-year old wood ought to be left at their base. They may be planted 6 inches apart, in rows 1 foot distant, in light rich mould, in a shady border; or, what is better, they may be potted, and plunged in a moderate hot-bed till they strike good root, when they may be hardened off and put out of doors. In either case, only one or two of the buds should be left above ground, and gentle waterings must be given from time to time, so as to keep the soil sufficiently moist, but not wet. During the winter protection should be given in severe weather, and in the spring or autumn of the following year, they may be planted out in nursery rows. Cuttings made in autumn ought to be taken off with a small portion of two-year old wood, when the shoots are well matured. They should then be planted, as above, in a shady situation, and protected from severe frost in winter. They may remain in the open ground till they make good roots, or may be taken up in spring, potted and plunged in a hot-bed to accelerate the production of roots. Another mode consists in taking, in spring, the most perfectly matured portions of shoots of the preceding year, and cutting them into as many pieces as there are buds; these pieces are then placed upon their side, with the bud upwards, in light rich soil, and covered to the depth of $\frac{1}{2}$ inch. If the ground is kept sufficiently moist, the buds soon vegetate, and roots are emitted from the under side of the cutting. Bearing branches, and even large limbs, will strike root with facility, and are sometimes employed instead of cuttings of the shoots, especially when the object is to obtain a tree which will bear in two or three years. They should be inserted in autumn, in good soil, to the depth of 2 or 3 feet, according to the size of the branch and the depth of the soil; and, if of large size, should be supported in an upright position by a stake. At planting, the

laterals ought to be shortened back a little, and, if possible, to a wood-bud at the base of a young shoot; at the same time a good shoot should be preserved as a leader. Afterwards, a good supply of water should be given, and when the branch has taken good root, a portion of the lower branches should be removed every year in order to form a clean stem; but care must be taken not to deprive the tree of too large a portion of foliage at any one time, otherwise its health and vigour are likely to be seriously affected in consequence.

By far the most common mode of propagation is by layering the young branches, either in autumn or spring. In performing this operation any of the usual modes may be adopted; but, as the most eligible branches are generally far from the ground, and cannot be brought down, it is frequently necessary to surround the branch with soil supported in a pot or box, and kept constantly moist. A ring of bark should be removed from the branch where it passes through the soil, when this mode is practised.

The tree may also be propagated by heading down and moulding up, in the same manner as the quince; but plants so obtained are generally long in coming into bearing.

Layers may be severed from the tree in the autumn of the year after they are laid down, if found sufficiently rooted, and may then be transplanted into nursery rows.

In this country the mulberry is rarely grafted, budded, or inarched; although these operations may be advantageously performed with the view of inducing early bearing, and to render fruitful the trees, whether from seeds, cuttings, or layers, which naturally produce only male blossoms. Inarching is the most certain mode of proceeding, at the same time it is the most inconvenient to practise, especially with large trees. The operation should be performed in spring, after the leaves have expanded. Grafting, when the sap begins to flow in spring, is rarely successful with this tree, owing to its bleeding; but it is probable that success would be insured, as in the case of the vine, by taking off the scions before vegetation commences, and working them when the leaves are developed and capable of appropriating the superabundant sap. On the Continent, flute-budding, ring-budding, and budding with a dormant eye are successfully employed, and are considered the best modes of insuring the objects of grafting. Flute-

budding is performed when the sap rises in spring, the other two operations before the descent of the sap in the autumn; and, if the bud succeed, the portion of the stock above it is cut off in the following spring.

Young plants in the nursery should be trained to a straight stem; and, as they increase in size, transplanted every second or third year to wider distances apart; when their stems are 3 or 4 inches in circumference they may be taken up early in spring, and planted where they are to remain. In planting, a large hole should be made, and the roots must be extended at full length; afterwards the hole should be filled up with good rich soil, or old hot-bed mould. The mulberry is generally trained as a standard, and planted in the orchard, or on lawns, in order that the fruit may not be damaged by its fall from the tree, but it is always better to keep the ground beneath dug. The tree will also succeed as an espalier, and in cold localities it may be trained against a wall with a south aspect, on which, however, it occupies a much greater space than can well be spared in such situations.

As a standard the tree requires but little pruning. The leading upright shoot should be cut at the proper height, and three shoots originated for principal limbs. These shoots ought to be subdivided into two each. An equality of growth should be maintained among these, so as to form a well-balanced head, as directed in the chapters on pruning and training. On walls, the fore-right shoots must be pinched, in summer, to six buds, and if they push again, they should be cut back to within four buds from the base.

Beyond pruning, as above directed, the tree requires but little culture, it being merely necessary to dig over the ground about the roots in autumn and spring, and to keep it free from weeds. The fruit ripens in succession in August and September, and should be gathered when about to drop. If the tree is not growing on a lawn, grass mowings should be spread out in a layer, not so thick as to ferment, in order to prevent injury to such fruit as may fall before it can be gathered. It does not keep good more than a day or two, and the sooner it can be used after gathering the better.

Besides the common mulberry, the only other species worthy of mention on account of its fruit is the red mulberry, *Morus rubra*, a native of North America, producing berries

of a dark red colour, but greatly inferior in quality to those of the common sort.

CRANBERRY (*Oxycoccus*, Pers.—Octandria Monogynia, L.; Vacciniæ, D.C.; Vacciniaceæ, Lind.)—Of this there are two species, valued on account of the fruit, namely, the American and the Common cranberry.

The AMERICAN CRANBERRY (*Oxycoccus macrocarpus*, Pers.) is a hardy trailing shrub, a native of North America, where it is found in boggy ground, swamps, and on the borders of lakes. The fruit is highly esteemed for tarts, preserves, &c., for which purposes considerable quantities are annually imported into this country. It may be cultivated in beds of peat soil, or bog earth formed in a moist situation, and so that their surface may be about 6 inches below the level of the surrounding ground. In these, the roots should be planted 2 feet apart, early in autumn, or in spring when all danger of frost is over. The plants soon spread in all directions and cover the beds; and in no case should they be allowed to suffer for want of water. Propagation is easily effected by layers, or by dividing the roots.

The COMMON CRANBERRY (*Oxycoccus palustris*, Pers.), a native of Britain, produces a deep red, very acid fruit, which, though inferior to that of the American cranberry in size and quality, is nevertheless very excellent in tarts and preserves. The plant may be grown in beds formed by digging out the ground at the side of a clear pond or running water, so that the bottom of the excavation may be about 6 inches below the surface of the water, and then filling in peat or bog earth or stones to the depth of about 9 inches. The plants may then be planted and the water let in.

THE BILBERRY, or BLÆBERRY (*Vaccinium Myrtillus*, L.—Octandria Monogynia, L.; Vacciniæ, D.C.; Vacciniaceæ, Lind.) is a deciduous shrub, growing to the height of 1 or 2 feet, and commonly found on stony heaths in various parts of Britain. The fruit, a small berry, is dark purple, and has an agreeable, slightly acid flavour. It makes excellent tarts and preserves. The plant is propagated by layers, and may be grown in peat soil mixed with garden mould.

THE BERBERRY (*Berberis vulgaris*, L.—Hexandria Monogynia, L.; Berberidæ, D.C.; Berberidaceæ, Lind.) is a deciduous shrub, growing to the height of 7 or 8 feet, a native of Britain and most parts of Europe and North

America. It is found wild in woods and coppices in dry soil, and was formerly common enough in hedgerows, but is now everywhere banished from these in consequence of the plant being very generally supposed to produce the rust on corn growing in its vicinity. The fruit when ripe is acid and astringent, but makes excellent preserves; those made at Rouen from the stoneless fruit are held in high estimation. In a green state the berries are pickled in vinegar. The principal varieties are:—

1. COMMON RED-FRUITED.

2. LARGE RED-FRUITED (Epine-vinette à gros fruit rouge).

3. PURPLE-FRUITED (Epine-vinette à fruit violet).

4. WHITE BERBERRY (Epine-vinette à fruit blanc).

The stoneless fruit, which is sometimes considered as a distinct variety, is produced by old plants which have been propagated by layers.

The berberry may be raised from seed, but is generally propagated by suckers, taken off in autumn, by dividing the plant, or by layering the young shoots. The layers are frequently two years before they make good roots, and should be separated from the parent plant in autumn. The plant will grow in any good garden soil, but bears best in one that is rich, light, and rather dry. All the culture it requires is to remove suckers so as to leave only a single stem, and to prune in all branches that are inclined to straggle too far.

BRAMBLE (*Rubus*—*Icosandria Polygynia*, L.; *Rosaceæ*, D.C.; *Rosaceæ*, Lind.)—There are several species and varieties of bramble, in some of which the fruit is of excellent quality for making pies, tarts, and preserves; in others it is of a very inferior description, but all appear to be susceptible of improvement by cultivation. Some account of the different kinds and their productions may therefore prove useful, and may lead to experiments being made for their improvement; and such attempts cannot be regarded as hopeless, when we reflect upon the immense difference which exists between our fruits in their wild state and when cultivated. The principal species of bramble are:—

1. COMMON (*R. fruticosus*, L.)—A native of Britain. Stems strong, angular, of a dark red colour, armed with strong hooked prickles. Leaves pedate, dark green. Flowers pink. Fruit purplish black, composed of numerous small grains, of an agreeable sub-acid flavour. There is a variety called the White-fruited bramble, which has white flowers, and produces a globular, some-

what flattened fruit, composed of light green transparent grains of a sweetish taste.

2. RED-FRUITED (*R. suberectus*)—A native of Britain. Stems nearly erect, 3 or 4 feet high, sparingly armed with small, purple, deflexed prickles. Leaves shining dark green, usually composed of five leaflets, but sometimes of seven, on the fruiting branches ternate. Flowers large, white. Fruit small, dark red, composed of few grains, acid.

3. HAZEL-LEAVED (*R. corylifolius*).—A native of Britain. Stems long, trailing, armed with numerous prickles, which are nearly straight. Leaves quinate, on the bearing branches always ternate, light green. Flowers white. Fruit large, black, glossy, composed of few but well-swelled grains, juicy and agreeably acid. A good bearer.

4. DEW-BERRY—syn. Blue Bramble (*R. cœsius*, L.)—A native of Britain. Stems weak, trailing, armed with numerous small deflexed prickles. Leaves ternate, light green. Flowers white. Fruit small, black, composed of a few large grains of an agreeable acid flavour. A shy bearer, many of the flowers proving abortive.

5. CUT-LEAVED (*R. laciniatus*).—Stems somewhat upright, the barren ones long, spreading, and armed with strong recurved prickles. Leaves dark green, composed of three or five leaflets deeply cut. Flowers rose-coloured. Fruit large, black, composed of well-swelled though not numerous grains, agreeably acid. A good bearer.

6. BUCKTHORN-LEAVED (*R. rhamnifolius*).—A native of Britain. Stems very long, trailing, armed with straight, deflexed, reddish prickles. Leaves generally quinate, bright green. Flowers white. Fruit large, composed of well-swelled grains, agreeably acid. An abundant bearer.

7. GLANDULAR (*R. glandulosus*).—A native of Britain. Stems long, trailing, armed with numerous deflexed, somewhat hooked prickles. Leaves on the flowering stems ternate, on the barren quinate, bright green. Flowers white. Fruit small, black, composed of numerous grains, of good flavour.

8. SHINING-LEAVED (*R. nitidus*).—A native of Britain. Stems spreading, inclining to grow erect, sparingly armed with hooked prickles. Leaves ternate on the fruiting stems, quinate on the rest, bright green. Flowers white. Fruit small, black, composed of a few prominent grains, rather acid.

9. DWARF CRIMSON (*R. arcticus*, L.)—A native of the mountainous parts of Scotland, as well as of Sweden, and other parts of the north of Europe. Stems herbaceous, erect, 3 or 4 inches high, not armed with prickles. Leaves ternate. Flowers crimson, on a solitary stalk. Fruit resembling a raspberry in colour, composed of a few large grains, very fragrant, and partaking of the flavour of the raspberry and strawberry combined. It is raised from seed, and may also be propagated by its creeping roots. It should be grown in peat soil mixed with loam, in a cool, rather moist situation. Both flowers and fruit are very ornamental.

10. CLOUDBERRY—syn. Mountain Bramble (*R. Chamaemorus*, L.)—A native of Britain, where it is found in the highest mountains, as well as of other parts of the north of Europe. Stems herbaceous, about 4 inches high, not armed with prickles. Leaves simple heart-shaped. Flowers white, and borne singly on the stem. Fruit large, of a tawny yellow colour, when ripe of a pleasant, agreeably acid flavour. It makes excellent preserves. The plant may be propagated by seed as well as by its creeping roots, and requires to be grown in peaty soil.

Brambles may be raised from seed or layers, but the latter seldom take good root till the second year; a better and more expeditious method is to cover the point of the shoots with soil, in consequence of which they make plenty of roots the first year. The species with herbaceous stems require to be grown in peaty soil, the others will succeed well in any good garden ground, and may be trained like raspberries, either to upright stakes, or they may be arched, which is doubtless for them the more natural way; and the shoots of the current year may be disposed in circles round the centre of the plant, and kept in their position by means of pegs. With the exception of cutting out superfluous shoots and dead wood, no further care will be required.

CHAPTER XIX.

THE NUT, WALNUT, AND CHESTNUT.

THE NUT (*Corylus Avellana*, L.—*Monœcia Polyandria*, L.; *Amentaceæ*, D.C.; *Corylaceæ*, Lind.) is a native of Britain and most European countries. It is extensively cultivated in the south of Europe, especially in Spain, which is celebrated for the size and quality of its nuts, and exports them in large quantities. It is also much grown in some parts of Kent. The varieties were formerly divided into two classes, namely—*short-bearded*, in which the husk extended but little, if any, beyond the nut; and *long* or *full-bearded*, commonly called filberts; but, as there are now several sorts intermediate between these extremes, the distinction can no longer be maintained.

The most esteemed varieties are:—

1. **RED FILBERT**—syn. Red Hazel, Avelinier Rouge, Blutnuss, Landschuppen, Langbartsnuss, Rothe Lamberts-nuss.—Husk long, tubular, hispid. Nut middle-sized, ovate; shell thick; kernel covered with a crimson pellicle; flavour good. Tree a good bearer.

2. **WHITE FILBERT**—syn. Wrotham Park, Avelinier blanche, Weisse Lamberts-nuss.—Husk long, tubular, contracted round the apex of the nut, hispid. Nut middle-sized, ovate; shell thick; kernel covered with a white pellicle; flavour good. Tree a good bearer. This and the preceding are much esteemed, because they can be longer kept in the husk than the other kinds, owing to its long tubular form.

3. **COSFORD**—syn. Miss Young's, Thin-shelled.—Husk nearly the length of the nut, deeply divided, slightly hispid at the base, expanding but not becoming reflexed when the nut is ripe. Nut large, oblong; shell light

brown, very thin; kernel filling the shell, white, sweet, and very good. Tree a good bearer. It ripens rather early, and is highly deserving of cultivation.

4. **SPANISH**—syn. Cob, Great Cob, and Large Cob of some, Lambert's, Lambert's Large, Large Bond Nut, Sir John Aubrey's, Token.—Husk smooth, longer than the nut, which is very large, oblong; shell thick, nearly filled with the kernel. Tree of rather upright growth. Being a very large variety, it deserves cultivation.

5. **COB**—syn. Downton Large, Prolific, Dwarf Prolific, Glasgow Prolific, Saint-Grisier; Barcelona, Great Cob, and Large Cob of some.—Husk short, hispid. Nut large, short, ovate, slightly compressed; shell very thick and hard, generally well filled by the kernel, which is of good quality, very like the Barcelona nuts of commerce. Tree of a strong upright habit of growth, and a good bearer.

6. **BOND NUT**—Husk hispid. Nut middle-sized, ovate, oblong; shell thin, well filled by the kernel. Tree a good bearer.

7. **DOWNTON LARGE SQUARE**—Husk smooth. Nut large, short, four-sided, rounded at the corners; shell thick; kernel very good.

8. **FRIZZLED FILBERT**—syn. Cape Nut, Frizzled Nut.—Husk about twice the length of the nut, deeply divided, spreading open at the mouth, frizzled, hispid. Nut small, oblong, flattened; shell rather thick, well filled by the kernel. It ripens rather late; and the tree is hardy and an abundant bearer, producing the nuts in clusters of three or more.

In addition to the above, the Burn nut, Great Cob, and Large Round Cob may also be mentioned as good sorts, and the Purple-leaved, on account of the ornamental appearance of its foliage.

Propagation.—The nut may be propagated by seed, layers, suckers, and grafts.

For propagation by seed the nuts should be gathered when quite ripe, and laid in the sun or in an airy place protected from rain, until they drop out of the husk or can be readily taken out. They should then be kept in sand, and sown, in October, in rich, light soil. Though this mode may be adopted on a large scale, yet, as the nuts, when so treated, are liable to be attacked by mice, it is generally better to stratify the nuts, and plant out in nursery rows in spring. Plants raised from the nuts of good varieties are rarely so good as their parents, but answer well for planting in woods for rods, hoops, and other purposes; or they may be reared with single stems, and grafted with any of the improved sorts.

Layering should be performed in autumn, or any time before spring that the weather may permit. The layers will generally be fit for taking up and planting in nursery rows, 3 feet apart and 1 foot asunder in the row. Some prefer plants from layers to those raised by any other mode.

Propagation by suckers is the mode usually adopted in Kent, where they are generally taken from the parent plant in autumn, short-

ened to 10 or 12 inches, and planted in nursery rows, where they remain three or four years.

Propagation by grafting is not the usual mode, but it may be very advantageously employed in some cases. The grafts take readily, and if a strong growing sort be grafted on one that is less vigorous, fruitfulness will be induced, and over-luxuriance checked. Whip-grafting is the best mode, and the operation should be performed in the end of February or in March.

Soil and Situation.—The nut will grow in almost any soil; but that in which it is most fruitful is a loam upon a dry sandy rock; for such, according to the Rev. William Williamson (*Horticultural Transactions*, vol. iv. p. 146), is that part of Kent where the nut is chiefly cultivated. It succeeds very well in sandy loam, or in a mixture of loam and brick rubbish. In strong, moist, loamy soils, the trees are apt to grow too much to wood. In the warm parts of the Continent, they are planted towards a northern exposure, but in this country a southern slope is the best.

Culture.—The distance between the trees may be 10 feet each way, and then they must be kept within limits by pruning, so that they may not shade each other. If the soil is not naturally rich, if it is thin, sandy, or rocky, manure of some sort should be given every year, especially if the trees bear heavy crops. Old woollen rags are found to be a good manure, and the decayed prunings and foliage of the trees themselves are likewise used with advantage. Manure is applied by laying it on after having removed the surface soil for some distance round the tree in autumn. When the soil is removed, all suckers should be carefully eradicated, otherwise manuring will be of little avail, for the nourishment afforded by the manure will be carried by the sap into the suckers rather than through the vessels of the old stem. Keeping the plants clear of suckers is a most important point in the cultivation of the nut; if, indeed, it is not of all others the most important.

Pruning.—The plants should be reared, in the first instance, with a single stem, and in autumn it should be cut at 18 inches from the ground. If, after the final planting, the stem should appear too weak, it will be advisable to allow the plant to grow at freedom, except in respect to suckers, none of which should be permitted to expand their foliage, but must

be displaced as soon as they can be discovered. When the plants have grown for one season, those that have too weak stems should be cut down near the ground, and only the strongest one of the shoots which subsequently push, should be permitted to grow. It should be trained erect during the summer, and cut back in autumn to 18 inches from the ground. This constitutes the upright stem, 1 foot of which should always be kept quite clear of shoots. If above this height six sufficiently strong shoots push, let them be inclined outwards and at equal distances from each other. This can be done with the greatest regularity by means of a hoop placed in the centre. If six good shoots cannot be obtained, select three of the best, and endeavour to grow these three of equal strength during the summer, and cut them back to within 4 or 5 inches from their base. In the following summer two shoots from each of these three will become the origin of six branches for forming the head. The leading shoots of these branches require to be shortened more or less at every winter pruning. How far they should be shortened back depends on the soil and climate. The object is to cause the shoot to push laterals along its whole length, instead of being naked near its base, as would otherwise be the case; and this will be insured by cutting off two-thirds; but one-half or one-third may, under some circumstances, be found sufficient. In Kent, the trees are not allowed to exceed 6 feet in height, and, in many cases, not more than $4\frac{1}{2}$ or 5 feet. In consequence of the leading shoots being thus shortened, laterals will be abundantly produced. If any of these are likely to grow too strong, they should be checked by pinching. In autumn, the laterals should be shortened back nearly close to the stem, and in consequence of this, two or more shoots will push from their bases, which would not otherwise have been the case. If the plant is not growing too luxuriantly to wood, these shoots will bear fruit. If they are too numerous, they should be thinned; and if any are too strong for the others, they should be checked, for by this means the flow of sap will be equalized, and then not only will productiveness be induced, but the fruit will be well nourished and of large size. It should, however, be borne in mind, that if any shoot is allowed to push with excessive vigour in any part of the tree, the fruitfulness of the other parts will be rendered uncertain.

It should be understood that the nut is monoecious, that is, male flowers, ♂, Fig. 39, and female flowers, ♀, are produced on the same plant. The male flowers, those long pendulous catkins, appear in winter; but the female flowers are not visible till spring, and are then rather inconspicuous. The bud containing a female flower is a little more plump than the ordinary wood-buds, and from its apex several deep crimson thread-like styles are protruded in spring. The pollen of the male flowers being essential to fertilization, if there are no catkins, or if they are cut off in pruning, before the female flowers appear, there can be no fruit. It is, therefore, necessary to save a good number of catkins when the trees are pruned; if this can be done, it is best to prune in January, but if the catkins are scarce, it is advisable to delay pruning till the female blossoms have been for some time expanded; and even then, if the catkins are so situated that, in order to give the tree a symmetrical form, they would have to be cut away, it is well to leave some of the shoots which are best furnished with male blossoms, for a week longer.

As already observed, the laterals generally bear the fruit. They should be shortened to a female blossom-bud as early in spring as these can be discerned. Occasionally some of the shortest twigs, with a blossom-bud at the extremity, may be left unpruned; but laterals that have borne should be cut back to two eyes, or within $\frac{1}{2}$ inch of the branch from which they proceed.

Gathering and Storing.—Nuts may be gathered for immediate use when the husks become brown; but for keeping, they should remain till ready to drop from the tree, and then be gathered when perfectly dry. The red and white filberts are the sorts best adapted for keeping in the husk. The base of the latter is succulent, and must be thoroughly dried before the filberts are packed for keeping. When the husks become dry, they are exposed by dealers to the fumes of sulphur, which doubtless prevent them from becoming mouldy. Others, when the husks are dry, pack the nuts in dry-ware casks, or in new flower-pots, with a sprinkling of salt, which also prevents mouldiness; others, again, put them in jars, and strew a layer of salt 1 inch thick over them before covering up. In all cases, when packed, they should be kept in a cool, dry situation, with a steady temperature.

Diseases and Insects.—The tree is rarely attacked to an injurious extent by either of these, but the crop is sometimes destroyed by the nut-weevil (*Balaninus nucum*), which pierces the tender shell of the young nut, and deposits a single egg in the interior. The maggot hatched from this feeds upon the kernel until it has attained its full size, when it eats its way out either before or after the nut has fallen to the ground, and buries itself in the earth, where it becomes a pupa. In the following summer it reappears as a moth, again to carry on its work of destruction. All that can be done to prevent the repetition of the mischief is to shake the trees in August, and having collected the fallen nuts to burn those which are perforated.

THE WALNUT (*Juglans regia*, L.—Monœcia Polyandria, L.; Juglandæ, D.C.; Juglandacæ, Lind.) is a lofty monoecious tree, a native of Persia and Asia Minor, whence it appears to have been carried into Greece at least three hundred years before the Christian era; then into Italy, France, Spain, and other parts of Europe. The date of its introduction into Britain is unknown; and though the tree is not recorded to have been cultivated till about the year 1562, yet the circumstance of a walnut-shell having been found, together with a large quantity of Roman remains, thirty-five feet below the surface, in excavating the foundations for the Royal Exchange in London, renders it by no means improbable that the walnut was brought into this country by the Romans. The fruit whilst young and tender is largely used for pickling, and when ripe it forms a favourite article of the dessert. An excellent oil, much used in the arts, is obtained from the kernel; and the wood being light, durable, and susceptible of a high polish, is almost the only one employed for making gun-stocks; it is also largely used by the cabinet-maker.

The principal varieties are:—

1. COMMON.—Fruit oval, not large, but well filled. Tree an abundant bearer.
2. THIN-SHELLED—syn. Noyer à coque tendre, Noyer mésange.—Fruit double, longer, earlier and of better quality than the preceding. It has a very thin shell, which is said to be frequently pierced by birds in order to get at the kernel.
3. LARGE LONG-FRUITED—syn. Noyer à gros fruits longs.—Fruit thin-shelled, very full, of excellent flavour, and produced in great abundance.
4. LATE—syn. Noyer tardif, Noyer de la Saint-Jean.—The principal merit of this sort consists in its not

flowering till the end of June, so that the crop is not exposed to injury from late spring frosts.

5. **LARGE FRUITED**—syn. French Walnut, *Noyer à gros fruit*.—Fruit very large, but must be eaten soon after gathering, otherwise it becomes hard and shrivelled. The tree is not a great bearer.

6. **LARGE DOUBLE**—syn. *Noyer à bijoux*.—Fruit very large, double, kernel good but soon shrivels. The shells are frequently used by ladies for holding gloves and trinkets, hence its French name.

7. **CLUSTER**.—Fruit produced in clusters of fifteen or twenty, thin-shelled, and of good flavour.

8. **DWARF PROLIFIC**—syn. *Noyer Fertile, Præparturiens*.—This variety is said to come into bearing when the seedlings are three years old, and to reproduce itself from seed. It may be trained as a pyramid, but the pruning for this purpose should be performed in summer, whilst the shoots are still in an herbaceous state.

9. **YORKSHIRE**.—Large but not double, well-filled, shell moderately thin. It ripens well.

10. **HIGHFLYER**.—Middle size, remarkably thin-shelled, and well filled. It ripens early. One of the best for this climate.

The walnut succeeds best in deep, sandy loams; calcareous soils, and stiff loams resting on a gravelly bottom, are also well suited for its growth. It requires plenty of room, as well as a free exposure to air and light; and in consequence of its not succeeding well in clumps or groups, the trees are generally planted in a single row in some open spot where their shade and wide-spreading roots will not prove injurious to other plants.

Propagation is effected by seeds, and occasionally by budding, grafting, and inarching, for the perpetuation of varieties. In raising from seed, only the best nuts should be selected, and these, having been stratified in sand in a cool place during the winter, may be planted in February or March, either where the trees are intended to remain, or in a nursery for transplantation. By the former method, the tallest and best trees for timber are obtained, whilst the latter mode is generally more convenient, and affords trees which come sooner into bearing and ripen their fruit earlier in the season than those not transplanted. The ground having been trenched 2 feet deep, and made fine, the nuts, if sown where they are to remain, should be placed 4 inches apart, in patches of three or four, and covered to the depth of 2 inches. In general, 60 feet may be allowed between the patches; but in rich, deep soil, 70 or 80 feet will not be too much. Afterwards, when the seedlings come up, only the strongest in each patch should be retained. If the plants are to be grown in a nursery, drills should be traced at $2\frac{1}{2}$ feet asunder, and in these the

nuts should be placed 18 inches apart. In the autumn of the year after sowing, and as soon as the leaves have fallen, every alternate plant should be taken up with a ball, and replanted elsewhere at 1 yard apart, the extremity of the tap-root having been cut off, in order to induce the production of fibrous roots. The next year, those not transplanted should be taken up, treated in a similar manner, and replanted somewhat further apart. As the plants increase in size, successive transplantations should take place every second or third year till the trees are finally planted.

Although the number of individual plants is increased by means of the seed, yet, as all varieties have originated in that way, and are still liable to vary again when that mode of propagation is adopted, other means must be resorted to in order to secure the reproduction of particular sorts with certainty. Grafting the walnut is seldom practised in this country, and it was long considered impracticable, till the error of this opinion was proved by the late Mr. Knight, in a communication read before the *Horticultural Society of London*, in April, 1832, and in which he says:—

“The walnut tree appears hitherto to have effectually baffled, under all ordinary circumstances, the art of the grafter. The inserted scions wither and die, without apparently making any effort to unite themselves to the stock, or to draw nutriment from it; and consequently the value of every superior variety has been limited by its use to the possessor of the original seedling tree. It is true that a part of the seedling offspring of every fine variety generally inherits a portion of its good qualities; but I have found it extremely difficult to obtain from seed good varieties of sufficiently early habits to ripen well in this vicinity, except in very warm seasons; and I doubt much whether the value of the crop of walnuts, throughout the British Islands, be one-third as great as it would be if proper varieties were everywhere planted.”

“The walnut tree,” continues Mr. Knight, “may be propagated with more success by budding. I have succeeded tolerably well in some seasons, and in one season perfectly well; but in several others not a single inserted bud has been found alive in the following year, though all had been inserted with the greatest care.

“I therefore communicate the following mode of grafting the walnut tree, which I

found in the last season most perfectly successful under many unfavourable circumstances; and which mode, for reasons which I shall proceed to state, will, I believe, point out the means of propagating some other species of trees with facility, which have not hitherto been so propagated without difficulty and uncertainty.

"The fluid which the seeds of the walnut tree contain, when that is fully prepared to germinate in the spring, and which was deposited within it for the purpose of affording nutriment to the seminal buds, or plumule, in the preceding autumn, is sweet, as in a great many other kinds of seeds: but during germination this becomes, in the seed of the walnut tree, bitter and acrid. Similar changes take place in the sap which is deposited, for analogous purposes, in the bark and wood of the walnut tree, during the germination of its buds; and I was led by the discoveries of M. Dutrochet to infer the probability, that the sap during, and subsequent to its chemical changes, might acquire new and more extensive vital powers. I therefore resolved to suffer the buds of my grafts, and those of the stocks to which I proposed to apply them, to unfold, and to grow during a week or ten days; then to destroy all the young shoots and foliage, and to graft at a subsequent period. A very severe frost in the morning of the 7th of May saved me the trouble of destroying the young shoots; but it deranged my experiment by killing much of the slender annual wood which I proposed to use for grafts, so that I found some difficulty in choosing proper grafts. The swelling of the small and previously almost invisible buds within a few days, enabled me to distinguish the living wood from that which had been killed by the frost, and the stocks were grafted upon the 18th day of May. My grafter had more than once been previously employed by me to graft walnut trees in various ways, and never having in any degree succeeded, he did not seem at all pleased with the task assigned him, and very confidently foretold that every graft would die: and I subsequently found that he had insured, to some extent, the truth of his prophecy, by having applied grafts which were actually dead. The whole number employed was twenty-eight, and out of these twenty-two grew well; generally very vigorously, many producing shoots of nearly a yard long and of very great strength; and the length of the longest shoot exceeding

1 yard 5 inches. The grafts were attached to the young (annual) wood of stocks which were between 5 and 8 feet high; and in all cases they were placed to stand astride the stocks, one division being in some instances introduced between the bark and the wood; and both divisions being, in others, fitted to the wood or bark in the ordinary way. Both modes of operating were equally successful. In each of these methods of grafting it is advantageous to pare away almost all the wood of both the divisions of the grafts; and therefore the wide dimensions of the medulla in the young shoots of the walnut tree do not present any inconvenience to the grafter. No difficulties will henceforth, I conclude, occur in propagating varieties of walnuts by grafting."

With regard to budding the walnut, the same distinguished physiologist observes:—"The buds of almost every species succeed with most certainty when inserted in the shoots of the same year's growth; but the walnut tree appears to afford an exception, possibly in some measure because its buds contain, within themselves, in the spring, all the leaves which the tree bears in the following summer, whence its annual shoots wholly cease to elongate soon after its buds unfold; all its buds of each season are also, consequently, very nearly of the same age; and long before any have acquired the proper degree of maturity for being removed, the annual branches have ceased to grow longer or to produce new foliage. To obviate the disadvantages arising from the preceding circumstances, I adopted means of retarding the period of the vegetation of the stocks, comparatively with that of the bearing tree, and by these means I became partially successful. There are at the base of the annual shoots of the walnut and other trees, where those join the year-old wood, many minute buds, which are almost concealed in the bark, and which rarely or never vegetate, but in the event of the destruction of the large prominent buds, which occupy the middle and opposite end of the annual wood. By inserting in each stock one of these minute buds, and one of the large and prominent kind, I had the pleasure to find that the minute buds took freely, whilst the large all failed, without a single exception. This experiment was repeated in the summer of 1815, upon two yearling stocks which grew in pots, and had been placed during the spring and early part of the

summer in a shady situation under a north wall, whence they were moved late in July to a forcing-house which I devote to experiments, and instantly budded. These being suffered to remain in the house during the following summer, produced from the small buds shoots nearly 3 feet long, terminating in large and perfect female blossoms, which necessarily proved abortive, as no male blossoms were procurable at the early period in which the female blossoms appeared: but the early formation of such blossoms sufficiently proves that the habits of a bearing branch of the walnut tree may be transferred to a young tree by budding, as well as grafting by approach.

"The most eligible situation for the insertion of buds of this species of tree (and probably of others of similar habits) is near the summit of the wood of the preceding year, and of course very near the base of the annual shoot; and if buds of the small kind above-mentioned be skilfully inserted in such parts of branches of rapid growth, they will be found to succeed with nearly as much certainty as those of other fruit-trees, provided such buds be in a more mature state than those of the stocks into which they are inserted."—*Horticultural Transactions*, vol. iii. p. 133.

The French graft the trees when the stems are from $3\frac{1}{2}$ to 5 inches in circumference. The methods employed are whip and cleft grafting, flute-budding, ring-budding, shield-budding, with a pushing eye, and herbaceous cleft-grafting; but whatever be the mode adopted, the sap must be in full flow at the time the operation is performed. For cleft-grafting the scions should be taken off in spring, before the rise of the sap, and laid with their ends in the ground in a north border, where they should remain till required for use. In grafting, care should be taken to cut the stock over above a shoot, opposite to which the scion should be applied. When the graft begins to push, this shoot may be pinched; and when success is no longer doubtful, it should be pruned. In ring-budding, which is only performed when the sap is in full flow, a ring of bark provided with an eye is taken from two-year-old wood, placed on the stock from which a similar ring has previously been removed, and the edges, having been accurately fitted together, are covered with grafting wax, but it is not necessary to tie up. In the following spring, the portion of the stock above the graft should be cut off. It may be remarked that this mode

of budding is also applicable to shoots and branches.

The final plantation may take place in the year after grafting or budding; it may either be performed in autumn, after the fall of the leaf, or in spring. The ground should be deeply trenched, and large holes having been made, the trees must be carefully lifted with balls and planted. In the spring, when all danger of severe frost is over, the graft may be shortened back a little, and at the same season in the following year, it should be cut back to five or six eyes.

As the trees form their heads naturally, little pruning is required; it is merely necessary to keep a straight stem by cutting off straggling growth, to prevent branches crossing each other, and to remove dead wood or that which is accidentally injured. The best time for performing these operations is in autumn, a little before the fall of the leaf.

For pickling, the fruit should be gathered whilst the shell is so soft that it can easily be pierced with a needle. When perfectly ripe, the husk opens, and at this time it is usual to beat the tree with rods; but this is at best a barbarous practice, and, where there is no danger of depredations, unnecessary, for the nuts, when ripe, drop, and may be collected from time to time. There is, however, a common prejudice, that thrashing the trees increases their fruitfulness, but it does not appear to be founded on fact. Where this mode of gathering is adopted, care should be taken to strike lightly, and not to bruise the buds upon which the future crop depends. After gathering, the nuts should be spread out in a layer about 3 inches thick, in a dry, airy place, and turned frequently till they easily part with their husk; and after having been thoroughly dried, they may be packed in alternate layers with sand in jars or casks, or they may be placed in jars, and salt scattered over them as they are put in. The jars should then be kept in a cool, dry place. Previous to use, the walnuts should be wiped perfectly clean with a cloth, and if the kernel is shrivelled they should be steeped for several hours in milk and water, to restore its plumpness and cause it to part readily from the thin pellicle with which it is covered.

Insects.—The walnut very rarely suffers from insects, to which the suell and astringency of the leaves appear to be peculiarly distasteful. The caterpillar of the wood-leopard moth (*Zeuzera cœsculi*) and that of the goat-

moth (*Cossus ligniperda*) occasionally attack the walnut, and greatly deteriorate the value of the timber.

THE SWEET or SPANISH CHESTNUT (*Castanea vesca*, Wild.—*Monœcia Polyandria*, L.; *Moreæ*, J.; *Corylaceæ*, Lind.) is a native of Asia Minor, whence it is supposed to have been brought into Europe by the Greeks, and having been carried to Italy, was probably introduced into Britain by the Romans. The fruit is generally eaten either roasted and seasoned with salt, or stewed in cream. In many parts of France, and especially in elevated situations, where cereals cannot be successfully cultivated, chestnuts constitute the chief food of the inhabitants, who kiln-dry them, and form the farina into a heavy and indigestible sort of bread, or make it into soups and puddings.

The principal English varieties are the **COMMON**, which is chiefly useful as a stock upon which to graft the other sorts, its fruit being small and little worth; the **DOWNTON**, syn. **Knight's Prolific**, and the **DEVONSHIRE**, syn. **Prolific**, **New Prolific**. Those reputed as the best French sorts, and which appear most worthy of trial in this country, are the **Exalade**, **Pourtalonne**, **Verte du Limousin**, **Marron Doré**, **Lyon**, **Marron de Craon**, **Marron du Lude**, and **Marron Franc du Limousin**, which is said to reproduce itself freely from seed. Another variety, the **Avant Châtaigne**, is mentioned by M. Leroy, the nurseryman of Angers, as being second rate, but very early. This being the case, there would be a better chance of its ripening fruit in seasons when, owing to a deficient amount of sunshine in the autumn months, the later sorts do not arrive at perfection.

The chestnut succeeds best in deep sandy soils and sandy loams resting on a dry subsoil. Calcareous soils are not well suited to its growth, and in stiff clays and retentive subsoils it seldom lives for any length of time. To ripen the fruit properly, a warm situation with a southern exposure should be chosen, for it is only in warm localities and in favourable seasons that it does so in Britain. On this account large quantities are annually imported from France.

Propagation is effected by grafting and budding for the continuation of the varieties, and by sowing the chestnuts, of which only the best-formed and most perfectly ripened should be chosen for the purpose. They may be sown

in October or November, but in this case are frequently eaten by rats and mice; and the young plants coming up in spring are liable to be injured by frost. For these reasons it is generally better to stratify the seeds in sand and sow in February or March, for in that case the seedlings do not come up till all danger of severe frost is over. In sowing, drills should be drawn 2 feet from each other, and in these the seeds may be deposited about 4 inches apart, covering with fine soil to the depth of 3 inches. Beyond keeping the ground clean, and stirring it occasionally, nothing further is required till the plants have attained the age of two years, when they should be taken up any time between October and March, about one-third of the tap-root cut off, and replanted 1 foot apart, in rows 2 feet asunder. A clean stem ought to be preserved by pruning off lateral branches; the young trees should be transplanted every other year, and, according to their growth, allowed more space. When they have stems about $1\frac{1}{2}$ inch in diameter, they should be carefully taken up in autumn and planted where they are to remain. A distance of from 30 to 40 feet may be allowed between the trees.

The fruit, when fully ripe, naturally detaches itself from the tree, and may be collected from time to time as it falls. In many cases, however, the chestnuts whilst lying on the ground are liable to be stolen, and for this reason are frequently beaten down with long poles as soon as the outer capsule begins to open; but in performing this operation great care should be taken not to injure the branches and young shoots. The chestnuts having been collected, should be beaten out of the husks and spread out in a thin layer in the fruit-room. Those not required for immediate use, after having been exposed for some time to the air, to part with a portion of their moisture, may be packed in alternate layers with dry sand, and kept in any dry place secure from frost.

CHAPTER XX.

GARDEN STRUCTURES.

I.—WALLS.

In the chapters on the formation of the fruit and kitchen garden, it was necessary to treat of the direction of the walls, that re-

quiring to be taken into consideration before ground operations could be properly commenced. In fact, the direction is of primary importance, and the details of construction may be safely left to a good builder; nevertheless, a few observations as regards the materials and modes of construction may be of utility.

It is generally understood that bricks are the best material for a garden wall. In those made near London, a considerable portion of sifted cinders is mixed with the clay, and thus a carbonaceous substance is introduced, which is next to indestructible, and the brick always retains nearly the same degree of hardness as it possessed when first burned. It is not so with bricks made entirely of clay, for they are liable to be softened and otherwise affected by moisture. Stone materials, however, answer perfectly well for garden walls, provided the stones are not so large as to occasion inconvenience in training. We have seen very fine fruit produced against a stone wall, equally good against a brick one, all other circumstances being the same.

Colour.—Of all others, white reflects the greatest amount of the solar rays, and of course absorbs the least. A dark colour, on the contrary, reflects the least, and consequently absorbs the most. In sunny weather, a black wall becomes hotter than a white one, and plants grown against it are then excited, but they are only rendered more susceptible of a check when cold and sunless weather supervenes. Fruit-trees upon blackened walls are brought somewhat earlier into blossom; but in our climate this is not generally a desideratum; and it has been found, in the case of a tree planted one-half against a blackened wall and one-half against one of the ordinary colour, that the blossoms on the dark portion expanded sooner, but that the fruit did not ripen earlier. It may therefore be concluded, that there is no material advantage to be derived from a black wall—none, in fact, that would compensate for its ugliness. As regards appearance, black is too gloomy, white too dazzling, and all glaring colours are disagreeable. Pale coloured bricks should therefore be employed in preference to red ones. So far as colour is concerned, any material that is of a subdued tint inclining to a light rather than to a dark shade, may be considered eligible, provided it is suitable in other respects. Stone colour is, we think, the nearest approach to white that should be chosen.

Height.—As garden walls serve as a fence, accumulate heat, afford shelter, and present a surface for training trees upon, these circumstances require to be considered in connection with the question of height. With regard to the first consideration, a wall 6 or 7 feet in height will answer perfectly well. As to the second condition, the higher the wall the greater is the amount of heat, partly reflected and partly accumulated during sunshine, to be given out to adjoining substances at all times when the air is colder than the surface of the wall. But it is known that a sort of fruit that will not ripen perfectly against a low wall will do so upon a high one. It therefore appears that the entire surface of a high wall becomes more heated than that of a low one. The difference may be estimated by the amount of shade caused by each. Let $a b$ (Fig. 232) represent the section of a wall

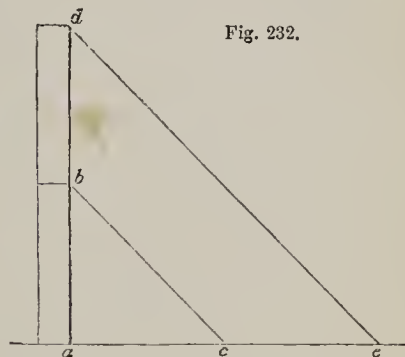


Fig. 232.

6 feet high, and 100 feet long, and supposing the sun to be at an elevation of 45° , then $a b c$ will represent a section of the shaded portion at the north side of the wall. The number of cubic feet of air deprived of the sun's rays behind the above length of wall, would be 1800. Carry up the wall to the height of 12 feet, and $a d e$ will become shaded; the number of cubic feet deprived of the sun's rays will then be 7200, or four times as much as when the wall was only half the height. We cannot say that the accumulation of solar heat on the other side of the wall would be exactly in the same ratio, for various circumstances would doubtless interfere, but certainly it would approximate thereto. From the above, and from what is actually known of the beneficial effects of a high wall on vegetation requiring a higher temperature than is afforded by a low wall, we arrive at the conclusion that high walls are the most advantageous, and the colder the climate, of course the higher they should be. In the southern

counties, and in other warm situations, 10 feet may be allowed for a south wall, but a height of 12 feet is better; and in the north walls, 15 feet or more in height would certainly prove very advantageous. We are here speaking of walls intended for utility. It is true that high walls surrounding a small garden are somewhat unsightly, and give a box-like appearance; but in such cases the south aspect wall may be made high, and that on the south side comparatively low, whilst the height of those on the east and west sides may be something intermediate between the two.

Thickness.—A wall of the standard thickness of 14 inches is as substantial as need be desired in gardens, and it may be carried up to a great height without the support of piers, provided the materials and workmanship are good. The next less thickness of a brick wall, as determined by the dimensions of a brick, is 9 inches; but to render this secure, if more than 8 feet high, it ought to have piers. With these, 4-inch walls, by which is meant $4\frac{1}{2}$ inches, or the width of one brick, may be built tolerably secure even to the height of 10 feet.

Foundations.—Garden walls have only their own weight to support, and therefore do not require to be so deeply founded as those of an equal height in buildings where there is the additional weight of floors and roof to bear; but the foundations ought to be 3 feet deep in order that they may not be loosened in trenching the ground, as well as to prevent the roots of trees from getting underneath them. The bottom of the trench for the foundation should be examined, and if parts are found of a softer nature than others, the bottom should be deepened and made up with concrete or other materials. Compact loam will bear a great weight without yielding, so long as it is dry or nearly so; but when wet, it squeezes outwards by the pressure, and the wall sinks. If this took place equally along the whole extent of the wall, as would be the case if the stratum of loam were uniform, it would be of little consequence; but if part of the foundation is on loam and part on gravel, a rent or shake is likely to take place. The base ought to be twice the thickness of the wall, whatever that may be, and the width should be diminished, as in

Fig. 233.

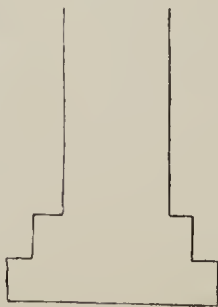


Fig. 233, by equal steps on both sides, each step being not more than $2\frac{1}{4}$ inches wide.

Solidity.—A brick wall 14 inches thick is unobjectionable; but hollow walls of the same thickness answer exceedingly well, for they can be made so as to present exactly the same appearance, and they are both dry and strong. Some hollow walls that were built thirty-six years ago in the garden of the Horticultural Society at Chiswick, cannot be distinguished from solid walls built at the same time, except by their sound, when tapped, or by cutting to the interior. They are warmer and more substantial than a 9-inch wall with piers, which requires nearly as many bricks as a 14-inch wall. In a wall 100 feet in length, and 10 feet high above ground, the number of bricks required for that 1000 square feet of wall surface would be, for a

14-inch solid wall, about.....16,000.

14-inch hollow wall, about.....12,800.

9-inch solid wall, with piers, about 11,060.

It will be seen from the above that, as compared with a solid 14-inch wall, there is a considerable saving of bricks in a 14-inch hollow one, but between this and a solid 9-inch wall with piers, the difference is not much, being only about 1740 bricks, probably not more than £2 as regards expense of materials—a mere trifle in comparison with the superiority of a 14-inch hollow wall both in appearance and utility. The piers are unsightly, as well as obstructive in training; and the shoots of fruit-trees thrive best against a plane surface unshaded by piers.

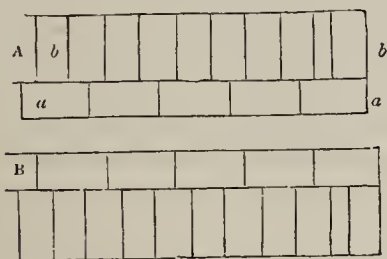
Construction.—Although this can only be done by practical masons and bricklayers, yet a gardener ought to know something of the principles, otherwise he would be apt to commit errors in cases where he may have to propose plans or give directions. For instance, he might, for support to a 9-inch wall, order piers 20 inches broad, and to project 6 inches from the wall. He would scarcely think of making the dimensions practical ones of $22\frac{1}{2}$ and $4\frac{1}{2}$ inches, unless he first took into consideration the size of the bricks; then he would find that these numbers bore a certain relation to the usual dimensions of bricks, $4\frac{1}{2}$ inches being the breadth of one, and 18 inches twice the length of a brick, making in all $22\frac{1}{2}$ inches, consequently the bricks would not require to be cut, as would have to be done in the other case.

Stone walls upon which trees are to be

trained, should not be built of large blocks; if the stones were dressed so as to make each course 6 inches, that is, equal to two courses of bricks, training could be very well performed without a trellis, which a greater distance between the courses would render necessary.

The usual size of bricks is nearly 9 inches in length, $4\frac{1}{2}$ inches in breadth, and $2\frac{1}{2}$ inches in thickness. In good work, each course is exactly 3 inches. The arrangement of the bricks should be such as to form a bond, that is, the joints of one course should be overlaid by the bricks of the one next above it, so that no two joints of any course shall be in the same line with a joint of the next course above it. There are two systems by which this can be readily effected; one is known as *English bond*, the other as *Flemish bond*. There are some old walls to be seen in which the bricks are laid according to that of English bond; but the Flemish bond has been almost universally adopted for more than a century. In Fig. 234, A represents a course of bricks of a

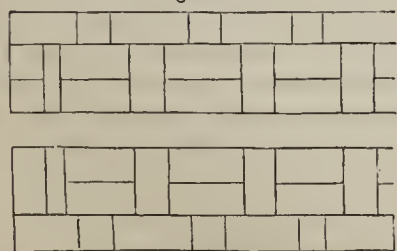
Fig. 234.



14-inch wall laid in English bond; the bricks disposed lengthwise in the direction of the wall, as *a a*, are termed *stretchers*; those placed lengthwise across the wall, as at *b*, are called *headers*: B represents the next course. Now, if we imagine it to be placed over the course A, it is evident that the stretchers will bond over the headers, and *vice versa*. Moreover, the internal longitudinal joint in one course is always bonded by the headers of the next course.

Fig. 235 represents the arrangement of the

Fig. 235.



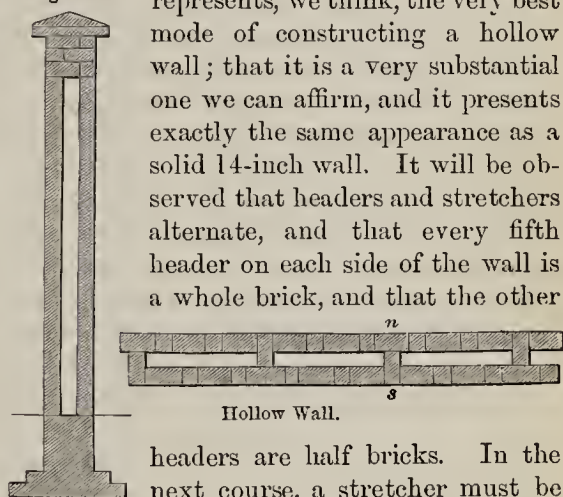
bricks in a 14-inch wall in Flemish bond, and

it will be seen from this, that instead of one course exhibiting only stretchers, and the next only headers, as in English bond, the headers and stretchers alternate in every course.

A 9-inch wall can be rendered very secure by piers 1 foot $10\frac{1}{2}$ inches broad, and projecting only $4\frac{1}{2}$ inches from the wall. They should be 12 feet apart, and ought to be carried up to within 2 or $2\frac{1}{2}$ feet of the top of the wall, and protected by a coping.

We are indebted to Mr. Sibthorpe for the accompanying plan and section (Fig. 236) of a 14-inch hollow wall, and it represents, we think, the very best mode of constructing a hollow wall; that it is a very substantial one we can affirm, and it presents exactly the same appearance as a solid 14-inch wall. It will be observed that headers and stretchers alternate, and that every fifth header on each side of the wall is a whole brick, and that the other

Fig. 236.



headers are half bricks. In the next course, a stretcher must be laid across the header at *s*, and a full-length header from the face of the wall at *n*. In the third course, the bricks should again be laid as in the first, or as represented in the figure; the fourth like the second, the fifth like the first, and so on, till within a few courses of the top, and these should be solid, as represented in the section. In this way, at intervals of about 30 inches, there are $4\frac{1}{2}$ -inch partitions, which are solid, except where the end of the header *s* may not touch the opposite stretcher *n*.

There are other modes of constructing hollow 14-inch walls, and which are well known to builders, but they are all, we consider, inferior to the above.

Hollow 9-inch walls are frequently constructed where solid ones are not required. The bricks are placed on edge with headers at greater or less distances apart, and either on edge or on the flat, according to the degree of strength that may be required in the wall.

Copings.—Stone copings are perhaps the best, but they are very expensive, and there are now various cements which form excellent substitutes, for instance Portland stone cement.

The coping should be raised in the middle, so as to allow the wet to pass off, and it ought to project about 2 inches beyond the surface of the wall on each side; a groove or throating for the drip should likewise be made in the under side of the projection. Some recommend a much greater width, in order to prevent radiation, and thus serve as a protection for the blossoms in spring. But there are several objections to wide permanent copings: they are very expensive, unsightly, and even if they project 6 inches, they would not answer so well for protection in spring as a broader temporary coping; whilst in summer they would prevent the foliage from being moistened by dew, the beneficial effects of which cannot be secured by artificial watering.

Temporary copings are of great utility, especially during the prevalence of late spring frosts. The heat accumulated in the materials of the wall during the day is abstracted whenever the air is colder than the wall. The cold air coming in contact with the surface of the wall becomes heated, and consequently lighter, it therefore ascends, and the heat is lost, so far as vegetation is concerned. Broad copings obstruct the free ascent of warm air which then accumulates where it is wanted, at the surface of the wall. We have seen the young shoots of vines cut off by frost as far as they had pushed beyond 9-inch coping-boards, whilst all below were safe.

For supporting 9-inch coping-boards, Mr. Atkinson had brackets permanently fixed in the wall, and on the upper side of these the boards were fixed by a broad-headed iron pin which passed through the board and upper side of the bracket. It would be better, however, to have the boards 1 foot in width; but a permanent bracket to support boards of that width would be unsightly when not in use. Perhaps the better plan would be to have iron tubes with an internal diameter of about 1 inch, and in length 4 inches more than the thickness of the wall, so that when inserted across, the ends would project 2 inches beyond the face of the wall. The tube should be secured by having a piece of iron fixed round its middle and built in the wall. A piece of rod-iron with an eye at top will answer the purpose, and if the cold tube is drawn through the eye when red-hot, it will afterwards remain quite tight. There should be a hole drilled through the tube horizontally, about 1 inch from the end, so as to admit an iron

pin about $\frac{3}{8}$ inch in diameter. A bracket should be formed with a round prong to fit into the end of the tube, where it can be secured by the iron pin being passed through a hole corresponding with that in the end of the tube, and on the brackets the coping-boards can be fixed, taking care that they fit closely to the wall, to the under side of the permanent coping, or, what is better, to both. If it should be desirable to have the coping-boards hinged, so that they may be folded up in warm weather, and let down in cold, the fixed tubes will also afford eligible means of doing so, for a wooden bar can be secured to the tubes so as to fit close to the coping, and to this bar the coping-boards may be attached by hinges. These should be such as will admit of the boards being removed, and the bar left, in case it should be wanted for supporting materials for protecting the fruit from birds and wasps. The tubular fixtures will also afford facilities for extending protecting materials to a greater or less distance from the wall, for this can readily be effected by means of rods pierced with several holes and inserted into the tubes, more or less according to the distance at which the netting or other material may be required to hang from the wall. When not otherwise occupied, wooden plugs, with neatly formed heads, should be inserted into the mouths of the tubes to keep out the wet.

Flued Walls.—Since heating by hot water has become so general, and the price of glass so much reduced, flued walls are less thought of than formerly; but good crops of various kinds of fruit have been produced on them, and in northern situations they are useful, not only in case of frosty nights in spring, but also for ripening the wood in autumn. Flued walls are generally built in a direction running more or less directly east and west, thus insuring a southern aspect; for the expense of artificial heat would not be well compensated if the trees had not the best exposure as regards sun-heat and light. The wall should be so constructed as to permit of the heat being readily communicated to the south side, whilst its access to the north side should be prevented as much as possible. In the base of the wall a flue should be built, having a cavity, say 6 inches wide and 18 inches deep; and the bottom of the flue should rest on bricks on edge placed 9 inches or 1 foot apart; elsewhere, it should be insulated. A small

cavity ought to be left between its sides and the brick-work of the wall, otherwise the latter, where in contact with the flue, would become too hot; it would also be well to have a clear space of 9 inches high above the top of the flue. The wall above this should be $4\frac{1}{2}$ inches thick next the south side, then there should be a 9-inch cavity, next $4\frac{1}{2}$ inches solid, then a $4\frac{1}{2}$ -inch cavity, and finally $4\frac{1}{2}$ inches solid. The wall will accordingly consist of three solid portions $4\frac{1}{2}$ inches thick, and two cavities, one of 9 inches next the front of the wall and in communication with the flue, and another of $4\frac{1}{2}$ inches, the use of which is to contain air, a slow conductor of heat, in order to prevent radiation from the north side of the wall. It must be remarked, that the walls ought to be tied together by some courses of solid brick-work at top, and further strengthened by piers. If at every 3 feet in the height of the wall, a course of brick or stone were carried from side to side, so as to connect the three $4\frac{1}{2}$ -inch walls, the strength of the structure would be greatly increased. Of course, openings would have to be left in these courses, to permit of the heated air ascending from the lower to the upper chambers.

A wall constructed nearly in the above manner may be heated by hot-water pipes; but as these may leak, it will be necessary to have openings in the wall opposite the joints of the pipes, in order that these may be readily examined.

II.—STRUCTURES FOR THE GROWTH OF PLANTS.

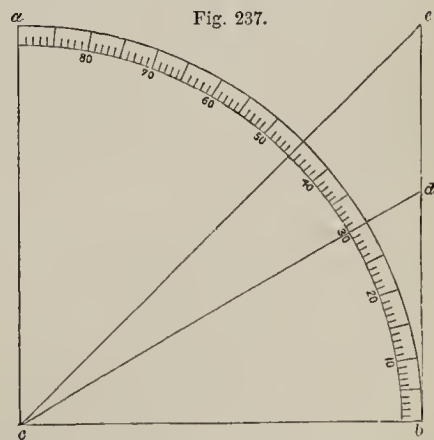
As regards horticultural structures for the growth of plants, there are certain principles which should always be borne in mind. Whatever may be the size or form of the structure, it should be impervious to wet, and as much as possible to the influence of cold air from without, or to the escape of warm air from within; still, ample means of ventilation should be at command: moreover, these conditions must be reconciled with that of the fullest admission of light. Before entering upon the kinds of structures for different purposes, it will be necessary to offer some explanations with regard to the angle of elevation of the roof, for on this the relative dimensions of the structure depend.

Angle of Elevation.—It is well known that the rays of light in passing through glass or any other solid transparent medium, lose much

of their energy as regards their effect on vegetation. If, after passing through the glass, the rays of light have a considerable space to traverse before they reach the foliage, the latter is insufficiently acted upon, even when the glass is very transparent; and when this is not so, either from its original quality, or from not being kept clean, their effect is still further diminished; and as regards the direct solar rays, the intensity of their action depends much on the greater or less obliquity of the angle at which they impinge upon the surface of the glass. All these being taken into consideration, it follows that the glass should be as close to the vegetation as circumstances will permit; that it should be bright, but more especially so if the plants are not very near it; and that it should be so placed as to form a plane, on which the sun's rays may be perpendicular at a period of the season when their greatest effect is most wanted; as, for example, when fruit that is being forced is undergoing the process of ripening.

As a general rule, houses intended for early forcing should have the glass more upright than those for later crops; and the angle of elevation should also be increased according to the latitude. If for any purpose an angle of 30° is proper in latitude 50° , then in latitude 57° an angle of 37° would be requisite.

Before proceeding further in this subject, it will be necessary to refer to Fig. 237, in which the lines $a b c$ comprise a quadrant or quarter of a circle, the arc of which, $a b$, is



supposed to be divided into 90 equal parts or degrees. Then, if $c b$ represent the width of a house and $b d$ the back wall, $c d$, the roof, will have an elevation of 30° . When the angle of elevation is 45° , it will be observed that the width of the house and the height of the back wall are equal, that the line of

roof *ce* cuts through half the quadrant, and that the angles at *c* and *e* are equal; but this is not the case with any other slope of roof whatever. Some designate the slope not according to the angle which it makes with the base, but with the back wall; whether it is the one or the other should be distinctly indicated, otherwise serious errors might be the consequence. Thus the angle *cbd* might be designated, counting from the back wall, an angle of 60° ; and if this circumstance were not mentioned, a house with a roof sloping 60° from the base might be constructed, when in reality an angle of 30° with the base was meant.

As the slope of the roof is dependent on the relative dimensions of the house, and *vice versa*, the following table, which has been constructed to show, by inspection, the angle of elevation rendered necessary by various dimensions, will perhaps prove useful. To use it, look for the width of the house, say 15 feet, in the left-hand column, and at top for the number of feet by which the back wall exceeds the front wall in height, say 12, and where the two columns intersect will be found $38^\circ 40'$, the angle of elevation, corresponding with that width of house and height of back wall above the front.

Width of House in Feet.	Height of Back Wall above Front Wall in Feet.														
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
5	21° 48'	30° 58'	38° 39'	45° 0'	50° 12'	54° 27'	58° 0'	60° 57'	63° 26'	65° 34'	67° 3'	68° 58'	71° 21'	71° 34'	
6	18 26	26 33	33 41	39 48	45 0	49 24	53 8	56 18	59 2	61 24	63 27	65 13	66 48	68 12	
7	15 56	23 12	29 44	35 32	40 36	45 0	48 49	52 7	55 0	57 32	59 45	61 42	63 26	65 0	
8	14 2	20 33	26 33	32 0	36 52	41 11	45 0	48 22	51 20	53 58	56 19	58 24	60 16	61 56	
9	12 31	18 26	23 57	29 3	33 5	37 52	41 38	45 0	48 0	50 43	53 8	55 18	57 16	59 2	
10	11 19	16 42	21 48	26 36	30 58	35 0	38 39	41 59	45 0	47 44	50 12	52 26	54 27	56 19	
11	10 18	15 15	20 0	24 26	28 36	32 28	36 2	39 17	42 16	45 0	46 50	49 46	51 51	53 45	
12	9 27	14 2	18 4	22 57	26 33	30 15	33 41	36 52	39 48	43 10	45 0	47 57	49 24	51 20	
13	8 44	13 0	17 6	21 2	24 47	28 18	31 36	34 42	37 34	40 14	42 3	45 0	47 7	49 5	
14	8 8	12 5	15 56	19 39	23 12	26 34	29 44	32 44	35 39	38 9	40 36	42 53	45 0	47 0	
15	7 35	11 17	14 55	18 26	21 48	25 1	28 4	30 58	33 41	36 15	38 40	40 55	43 0	45 0	
16	7 7	10 37	14 2	17 21	20 33	23 38	26 33	29 21	32 0	34 0	36 52	39 5	41 11	43 9	
17	6 42	10 0	13 14	16 24	19 26	22 21	25 12	27 54	30 28	32 54	35 13	37 24	39 28	41 25	
18	6 20	9 27	12 31	15 31	18 26	21 15	23 57	26 34	29 3	31 26	33 5	35 50	37 52	39 48	
19	6 0	8 58	11 53	14 44	17 31	20 14	22 50	25 21	27 46	30 4	32 16	34 23	36 23	38 17	
20	5 42	8 31	11 19	14 2	16 42	19 17	21 48	24 14	26 36	28 49	30 58	33 0	35 0	36 51	

The question now is, What are the best angles to adopt for houses intended for forcing fruits so as to ripen at different seasons, and for the growth of plants? It is well known that when the sun's rays fall upon glass in a perpendicular direction or nearly so, very few rays are reflected, but when they meet the surface of the glass in a very oblique or slanting direction, more rays are reflected than pass through it. According to Bouguer's table of the rays reflected from glass, of 1000, when the angle of incidence is

1°, 25 rays are reflected.	50°, 57 rays are reflected.
10, 25	60, 112
20, 25	70, 222
30, 27	80, 412
40, 34	85, 543

From this it will be perceived, that at angles of incidence from 1° to 30° the number of reflected rays is nearly the same, therefore the roof of a house may have as much as 30° higher pitch than that on which the sun's rays would fall perpendicularly, without any important diminution in the light transmitted to the interior. It is certain that any plane of glass, inclined so as to face the south at an angle equal to that of the latitude of the place, will

in the course of the whole year admit a greater number of the rays of light to pass through than would be the case at any other angle; but according to the above table, we may deviate as much as 20° higher or lower than that angle without any material difference. In other words, in latitude 54° the angle of roof may be as high as 74° or as low as 34° , without the transmission of light being materially affected. Therefore, between these limits we may choose any angle, according as the structure is intended for dwarf or tall plants.

It may be desirable to construct a house with a slope to which the sun's rays shall be perpendicular at any given period of the year, say on the 15th of August, at a place in latitude 54° . The rule given by the Rev. Thomas Wilkinson, in the *Transactions of the Horticultural Society*, vol. i. p. 162, is to make the angle contained between the back wall of the house and its roof equal to the complement of the latitude of the place, plus or minus the sun's declination for the day on which we wish his rays to strike perpendicularly. From the vernal to the autumnal equinox the declination is to be added; from

the autumnal to the vernal, it must be subtracted. Instead, however, of finding the slope of the roof by ascertaining the angle formed at top between the back wall and roof, it can be found more easily by calculating the angle of elevation. Thus, by Mr. Wilkinson's rule, we have $90^\circ - 54^\circ = 36^\circ$, the complement of the latitude, and adding to this 14° , the sun's declination on the 15th of August, we obtain 50° as the angle between the back wall and roof. It is true, we have only to subtract this from 90° and we have the angle of elevation 40° ; but to find this at once, it is merely necessary to *subtract* the sun's declination from the latitude between the vernal and autumnal equinox, and *add* it between the autumnal and vernal. Thus, 54° , the latitude, less 14° , the sun's declination, is equal to 40° , the angle of elevation which a roof ought to have, in order that the sun's rays may fall perpendicular upon it on the 15th of August, nearly eight weeks after the longest day; and it may be observed that they will do the same about the 27th or 28th of April, or eight weeks before the longest day. In order to have the sun's rays equally perpendicular at these periods in latitude 50° , the angle of elevation would require to be 36° ; in 51° , 37° ; and so on, increasing the angle 1° for every additional degree of latitude, so that in 58° the angle of elevation would require to be 44° . With this pitch of roof the sun's rays at midsummer would form an angle of 9° or 10° ; but this gives only $2\frac{1}{2}$ per cent. of loss, notwithstanding which they are still powerful enough at that period of the year. In structures where little fire-heat is employed, we have no hesitation in saying, that an elevation of 40° is as good as could be adopted. It is of great importance that the heat should be distributed as equally as possible throughout the whole of the interior of the house; for the sap naturally tends to flow with greatest force to the upper parts of plants, all circumstances being the same; but it is also attracted to where there is the greatest heat, and if this is at the top there is a double tendency to that part, whilst on the contrary the lower portion suffers no undue diminution in proportion. Now, the higher the pitch of the roof the greater the accumulation of heat in the upper angle; so we may say, the lower the pitch the less the difference between the temperature of the air at top and bottom of the slope. Owing to this it becomes desirable to keep the slope

as low as is consistent with the admission of abundance of light. On again referring to Bouguer's table, it will be seen that if the rays are not more than 20° from the perpendicular, the reflected rays are only 25 in 1000, or $2\frac{1}{2}$ per cent.; therefore the angle of elevation might be as low as 20° , but this would considerably lessen the extent of surface available for training the vine and peach, and drip would be more apt to fall on the leaves than if the elevation were greater. On the whole, as regards these fruits, it does not appear desirable to construct houses with roofs at a lower angle with the horizon than 30° for the general crop, nor higher than 40° , but for very early forcing an angle of 45° may be allowed.

Principal Forms of Plant Structures.—The outline of the roofs of these is either straight or curved, and again the glazed part may consist of one uniform slope, in which case the house is called a *lean-to*, or of two slopes in opposite directions, when it is said to be *span-roofed*; such may either be *equal*, when both sides of the roof are of equal pitch and length, or *unequal*, when one side presents a long slope, usually to the south, and a short one to the north. Instead of the roof consisting of one span formed by the inclination of two equal or unequal sides, it may consist of a series of spans; it is then termed a *ridge-and-furrow* roof.

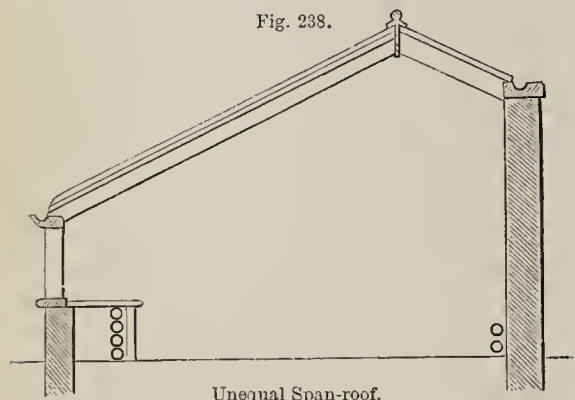
The *lean-to* is the form that would most probably be suggested after the shelter of walls had been taken advantage of; and even now there is no form by which a certain amount of light can be so readily admitted, and by which an elevated temperature can be so steadily and so economically maintained as by this. The back wall generally faces the north, so that whilst the glass presents a surface in the best position for receiving the rays of heat and light, the north side, from the nature of the materials, does not rapidly conduct heat from the interior, more especially when it is built hollow, or when it is protected to a considerable extent from wet and cold by buildings erected at the back.

Span-roofs.—The number of superficial feet of glass required to cover a certain area with a span-roof is exactly the same as when the lean-to form is adopted, the angle of elevation being the same in both cases, but the extreme height of the span-roof is only half that of the lean-to. This renders span-roofed houses very advantageous for the growth of plants

that are dwarf and cannot conveniently be placed in a lean-to so near the glass as they ought to be. Another advantage is the admission of light on both sides. When the rays of light fall chiefly on one side of a plant, it grows most to that side; but in a span-roofed house, light being admitted on both sides, equality of growth is more easily maintained. Much more fire-heat is, however, required for the span-roof than for the lean-to, especially if the house runs east and west, as in that case half the surface of the glass is exposed to the north.

Unequal Span-roofed Houses.—As already mentioned, these generally have the longest slope facing the south, consequently they are more economical as regards fuel than the equal span, because there is less surface exposed to the north. From any point of view that the inequality of the sides can be seen, such structures have an unsightly appearance. Their great advantage consists in the extreme height of the roof being considerably decreased by the high upper angle being cut off, as in Fig. 238, and thus the heated air cannot ac-

Fig. 238.



cumulate so much at that part of the house as if the roof had extended till it joined the back wall.

Ridge-and-furrow Roofs.—In covering a certain area with glass in one plane, as in the lean-to houses, or even those with a double span, the height of the roof must be considerable, in order to throw off the wet; but by adopting the ridge-and-furrow system this object can be effected with but little elevation of roof. A conservatory, for instance, may be constructed with glazed sides all of equal height, say 10 feet, and by covering it in on the ridge-and-furrow system, it is possible to do so without raising the top of the ridges more than 18 inches higher than the sides. This appears to be the only real advantage afforded

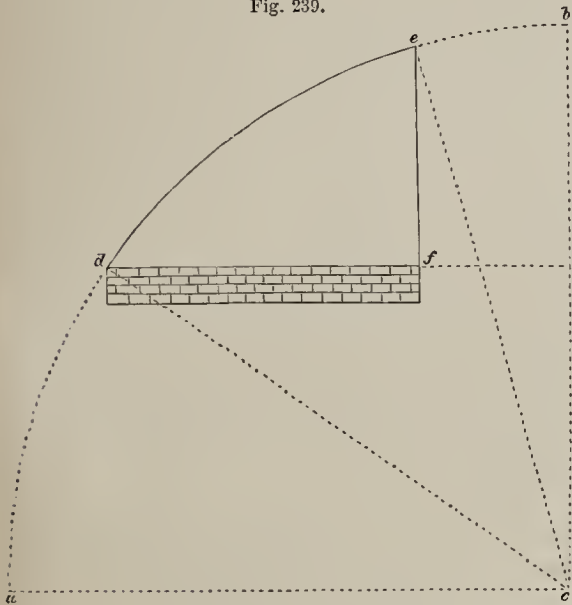
by this mode of construction. It may be observed, that the quantity of glass required to cover a certain area of base is the same, whether this is effected by one span, by a series of spans like the ridge-and-furrow, or by a single slope like a lean-to, provided the glass in all these cases is placed at the same slope. With regard to light, it will be readily admitted that through every square foot of glass placed at the same angle, the number of transmitted rays will be the same. Now, there is this difference between a ridge-and-furrow roof and one with a single slope: there is, as above stated, the same surface of glass in both if placed at the same angle, but when the sun's rays are perpendicular to one side of the ridge none of them can be so to the opposite one, in other words, the sun can possibly shine upon only half the surface of glass; whereas on a roof consisting of a single slope, the whole of the surface is exposed to the sun's rays, consequently twice the quantity of these will be transmitted into the interior of the house. In consequence of this, it can be affirmed that a ridge-and-furrow roof will be heated as much by the sun's rays as a span-roofed one, but much less so than a roof presenting one uniform slope. The latter is best for the ripening of fruits, whilst the ridge-and-furrow roof is suitable where less intensity of solar heat is required, and in cases where, in a lean-to and even in a span-roofed house, the plants would be too distant from the glass.

Curvilinear Roofs.—The principal advantage which these possess is, that they can be constructed so as to admit more light than those which are straight. The light admitted is in proportion to the relative quantities of opaque and transparent materials used; and in a straight roof the area of surface occupied by wooden materials is much greater than when iron is employed. Again, the curvilinear iron roof can be made lighter than a straight one of the same material; because, in the curved form, in order to support steadily the same weight, the bars do not require to be so thick as when they are straight. The curvilinear form is that by which the greatest amount of light can be transmitted; and in this respect it must be considered the most advantageous. On the other hand, it must be admitted, that whilst roofs of this description admit solar light and heat in greater quantity than where wood is used, yet they have the disadvantage of transmitting heat

more rapidly from the interior, as well in consequence of radiation taking place from a larger surface of glass than in a straight-roofed house of the same size, as from the iron employed in their construction cooling much more rapidly than the wood.

In constructing curvilinear roofs, it is desirable that they should form some segment of a sphere, and not that of a spheroid; and the question is, What segment is the best? On referring to Fig. 239 it will be observed, that if the whole quadrant abc were taken as the

Fig. 239.



Knight's Curvilinear House.

form, the glass near the base at a would be nearly perpendicular; whilst that at the top b would be almost flat—too much so for the rain to pass off readily. Another form was, however, proposed by Mr. Knight; and this we consider to be unobjectionable. It is represented by def , and is obtained as follows: With a radius of 25 feet describe the curve ab ; from the base cut off 35° , and from the summit 15° , as from b to e . This gives a house 14 feet wide and $10\frac{1}{2}$ feet high above the brickwork; and such a structure might be used either for forcing grapes and peaches, or as a plant-stove.

For growing fine specimens of some kinds of plants they ought to have the benefit of light on both sides. This leads to the construction of *curvilinear span-roofs*. The curves in such may be joined at top, or a space may there be left for ventilation.

In some cases the bars for curvilinear houses have been made of a uniform size; but although

these have been found to answer well for nearly forty years, and are still substantial, yet we think cast-iron ribs at every 12 feet are preferable, and such can now be made strong, light, and elegant. To these, purlins can be secured, and then the intermediate bars for the glass need not be so strong as would otherwise be necessary.

The greatest difficulty with regard to curvilinear houses is in securing proper ventilation; and those hitherto constructed have generally been defective in this respect. They require more air than straight-roofed houses; and, accordingly, there should be sufficient opening for its admission at or near the upper part of the curve. In the curvilinear span a longitudinal space can be left at top; but it ought to be much wider than architects are inclined to allow. Panes of glass can now be had of any required size and thickness; and by framing these, so that they could be turned on pivots by means of a rod, plenty of air could at all times be given. By adopting this mode there need be no interference with the framework of the roof, which would then be fixed according to the desired curve.

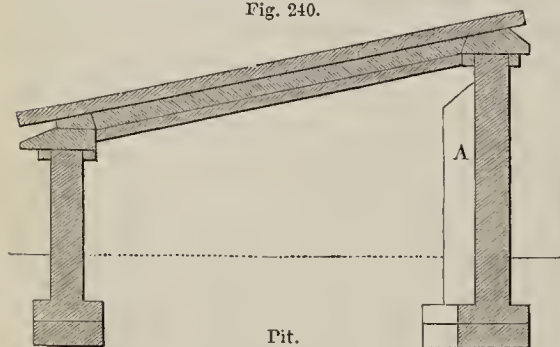
Frames are usually made of deal boards $1\frac{1}{4}$ inch thick. Their dimensions are variable; but the larger they are the less materials are required in proportion to the internal area. Thus, supposing the depth to be the same in both cases—say 12 inches—a frame 3 feet by 4 feet would require for the sides and ends 14 square feet of board, the space inside being only 12 square feet; whilst a frame 8 feet by 6 feet would require 28 feet for sides and ends, and the area inclosed would be 48 square feet: hence the larger, with only *twice* the quantity of materials for what is called the box of the frame, contains *four* times the space. It may also be remarked that the small and large frame both require the same amount of labour as regards the joining of the sides and ends. These are usually dove-tailed; but Mr. Atkinson had frames made with ends projecting beyond the front board, and in the external angles thus formed, as well as in the internal ones, triangular pieces of wood were fitted, and to these the sides and ends were nailed. In this way the box of a frame can be put together without dove-tailing, and by almost any person. These upright corner-pieces are also well adapted for taking the bearing of the frame when placed on posts or other supports. As regards duration, it is of little importance

whether frames are painted or not; for it has been ascertained that frames not painted will last as long as those which are, all other circumstances being alike; but paint preserves the surface so that it can be easily cleaned. If painted, frames should be white or light stone colour both inside and out, in order to reflect the light. Black, on the contrary, should be avoided, on account of its absorbing the sun's rays, and causing the wood to crack in consequence.

Pits.—The great utility of these structures is well known. In their simplest form, without artificial heat, they are useful for protecting many kinds of plants, which would either be killed or much injured by exposure to the open air in winter; and even in summer this kind of pit affords the most convenient means of sheltering delicate plants from heavy rain and scorching sun. With heat at command, pits are eligible for the purposes of propagation, nursing for larger structures, and forcing vegetables, flowers, and fruit. Before large structures are built, pits should receive consideration, for without them a good stock of plants cannot be brought forward; so that if large houses are finished before pits are commenced, the former must remain for a considerable time imperfectly furnished, instead of presenting a gay appearance immediately after they are finished; and this may be subsequently maintained, from the supply which pits in good working order can afford.

Pits are constructed in many different ways; but the simplest mode in which they can be adapted to answer well the purpose for which they are intended is the best. Fig. 240 re-

Fig. 240.



presents the section of a good, simple form of pit, which may be employed for almost any purpose, kindly furnished to us by Mr. Sibthorp, who for many years acted as Superintendent of Works in the garden of the Horticultural Society of London. An inspection

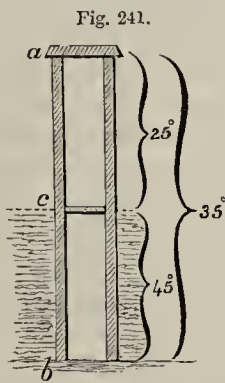
of the section referred to will enable any one to understand the construction of the walls of pits on a good principle. It will be observed that the width of the foundation is twice the thickness of the wall, the latter being 1 brick, or $4\frac{1}{2}$ inches; but at every third rafter the back wall is supported by a 4-inch pier, A. The wall-plates both at front and back project sufficiently to allow the drip to fall clear of the face of the walls. Fillets of wood fixed to the under side of the wall-plates, and as close as possible to each side of the wall, serve to maintain both the wall-plate and top of the wall steadily in their positions. The angle of elevation is about 12° . This, in a pit 6 feet wide, requires the back wall to be about 15 inches, or five courses of brick higher than the front wall. If the width is 7 feet, the back wall must be 18 inches, and if 8 feet, about 21 inches higher than that in front. On the same principles of construction pits may, as already observed, be built wider, and they may also be raised higher above the ground level, or the foundations may be sunk lower to give space for heating materials. In its present form, however, the pit above represented is well adapted for being heated by hot water.

When a strong heat has to be constantly maintained, as in the case of forcing by fermenting materials, pits require to be constructed so that the heat from linings may be admitted as readily as possible into the interior. The walls should therefore be built with openings, or in pigeon-hole fashion. If good materials are used, the thickness of the walls may be 4 inches or the width of a brick, and their foundation should be $2\frac{1}{2}$ feet below the surface. Above the foundation, the wall for three or four courses ought to be solid; then the bricks should be laid as stretchers, leaving, however, the breadth of a brick open between each. The back wall may thus be carried up to 15 or 18 inches above the ground level, and then it should be solid to the required height. Round the pit thus formed there must be a cavity for dung or other fermenting materials. It should be 2 feet wide at the bottom, which may be paved, and the side ought to be built of 4-inch brickwork, sloping back so as to give a width of 2 feet 3 inches at the ground line, above which it should form a low parapet about 9 inches high, well coped with stone or brick on edge, set in cement. In this coping, how-

ever, there should be inlets—say at 4 feet apart—for the ends of rafters to stretch across the cavity, and catch on a ledge of wood closely secured to the wall of the pit by bolts or holdfasts. Wooden shutters supported by these rafters should be made to fit, so as to throw off the wet from the linings, and give the whole a neat appearance. Both rafters and covers should be adapted so that they can be easily and quickly removed when the linings require to be turned and renewed.

Pits with hollow walls are warmer than those with solid walls composed of the same quantity of materials. The walls may be built very substantially on the same plan as that represented in Fig. 236, or they may be constructed in some cases securely enough of brick on edge, with a 4-inch cavity between.

Protecting pits are best constructed with hollow walls, because the space between being occupied with air, a slow conductor, the cold from the outside cannot readily pass to the interior, and consequently the plants are protected from the extreme cold to which they would be subjected were there no such interposition. Such would be the beneficial effects if the walls were only hollow above the surface of the ground, but a still greater advantage would arise from the foundations being deeply sunk and carried up hollow from a considerable depth. At 5 or 6 feet below the surface the soil will rarely be at a temperature below 45° . Then, let $a b$, Fig. 241, represent a hollow wall, $a c$ the portion above ground, $c b$ that below ground, and c a close partition. The air in the portion below this will have a temperature of 45° , or that of the soil with which it is in contact, whilst the portion above ground may, in time of very intense frost, be as low as 25° , and this would soon affect plants in the interior; but remove the partition at c , a mixture of the air above and below the surface c will take place, and a mean of 35° will result; then plants inside the frame will be safe that otherwise would have been seriously injured by frost, had there been no cavity with warm air beneath. The greater the surface of warm soil in contact with the air of the cavity, the more effectually will the cold above ground be counteracted. Therefore

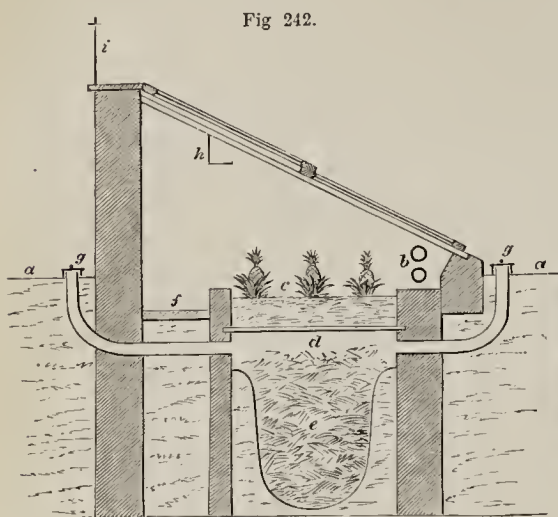


drains might be formed to communicate with the hollow of the wall at or near the bottom. It may be said that these would soon get filled with cold air; such, indeed, would be the case, because it is heavier than warm air, but then it would get heated by the warmth of the earth and ascend, and thus the hollow wall and its tributaries would form a warm medium throughout. From what has been stated it appears that deep hollow walls may be formed to economize the heat of the earth, and so preserve plants in better condition than would otherwise be the case without the aid of heating apparatus, and even where such is erected a saving of fuel as well as of protecting materials will be effected by their means.

When *cucumber* and *melon pits* are to be heated by hot water, the width of such a pit as that represented in Fig. 240 may be increased to 8 feet. A flow and return pipe will serve for bottom heat, and another flow and return pipe for top heat. The former should be laid in a chamber along which they may run $2\frac{1}{2}$ feet from the front wall, returning the same distance from the back wall. Those for top heat should run along the front, and be at least 3 inches apart, and above each other to save room. The chamber should be covered with slate thick enough to bear the weight of soil; and, to contain the latter, thick slates set on edge should form the sides and ends, and to support them in an upright position, pieces of brick may be set in cement between the slate and the wall of the pit, so as to act as stays. There should be a complete and separate command of both top and bottom heat, so that each may be worked much or little according to circumstances. The space between the walls and slate should have a wooden cover to make the chamber close if necessary, or to open and permit superfluous heat to ascend for use at top. With an unequal span-roof there may be a path at back, and a trellis for training the melons and cucumbers upon. The side of the chamber next the path might have close-fitting doors at intervals, so that some fermenting stable-dung could be introduced, not so much for heat as for supplying moisture and ammonia, in order to keep the plants healthy and free from insects.

Fig. 242 represents the principal pine pit or stove at Meudon, near Paris, where Queen pines have been grown to the weight of 10 lbs. There is a large stone vault under it which is filled with fermenting materials. The boarding over

the vault is supported by iron bars. From the great mass of fermenting materials, a large quantity of ammoniacal and carbonic acid gases



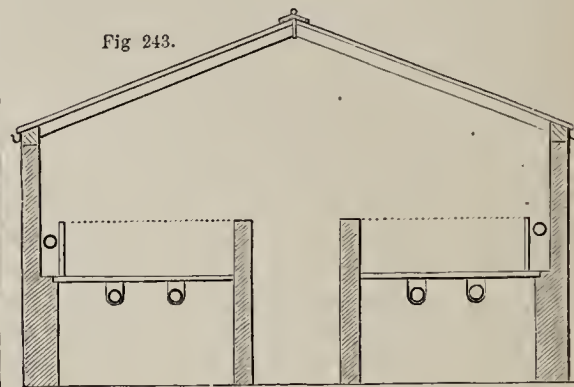
Meudon Pine Stove.

a a, Ground line. *b*, Hot-water pipes for top heat. *c*, Bed of peat soil in which the pine apples are planted. *d*, One of the iron bars for supporting the boarded flooring on which the bed of soil rests. *e*, Vault filled with stable-dung and leaves. *f*, Foot-path. *g g*, Air-holes. *h*, Shelf for strawberries. *i*, Iron rail over which the straw mats are hung when the house is uncovered.

must be generated. These will find their way through the boarding to the soil in which the plants are growing, and to this circumstance, doubtless, is to be attributed the remarkable growth of the pine plants at Meudon. The boards were not everywhere closely joined, for we observed that strong old pine-apple roots had penetrated through amongst the dung, or rather the mixture of dung and leaves; moreover, ammonia will pass through the fibres of the wood, and that more quickly than common air and other gases do. A vault can easily be made with little additional brickwork, for the foundations of ordinary pits have, in many cases, to be sunk nearly as deep as would be required for the sides of the vault. Therefore we should advise the adoption of this simple plan; if fermenting materials cannot be had in sufficient quantity to fill a vault, still enough could be had in most cases to ferment on the floor, and prove beneficial by the exhalations of ammonia. Then a flow and return pipe would give the additional amount of bottom heat which would be required.

Propagating pits are usually built so that the plants may be near the light; the path, therefore, is best in the middle; and there should be a good command of bottom heat under the bed of plunging materials. A form which answers very well for this purpose is

represented in Fig. 243. It is 11 feet wide, and 8 feet high from the path to the upper angle of the roof; and the path is 2 feet wide. There are two beds 4 feet wide, one on each side of the path, for plunging materials, ashes, tan, sand, or sometimes sawdust; and each has a flow and return pipe for bottom heat



Propagating Pit.

and one on each side for top heat; but if the house is required to be long, there should be two flow and return pipes for top heat; and then a high top and bottom heat will be perfectly at command.

Vineries.—The vine, from the flexible nature of its rods, can be trained in any direction, whether parallel with the glass or not, and either upwards, downwards, obliquely, or horizontally; and in any of these ways good crops may be obtained, provided the foliage is not too far from the glass. As a good border is generally afforded, the length of shoot made in a season is considerable; and if the vinery is of limited extent that form is the best which admits of the greatest length of shoot being trained so as to enjoy the greatest amount of light, and as nearly as possible an equal degree of temperature as regards the bottom and top of the plant.

Vineries are generally, and we think most properly built so that their front may present a southern aspect; either one directly south, or inclined to the south-west, in order to be acted on with the greatest possible effect by the sun's rays. Doubtless, some will object to this on account of scorching; but even the purest glass acts more or less as a screen, in passing through which the sun's rays are not so intense as they are when they strike upon objects freely exposed. There is of course an exception to this when the glass is not plane, for the rays would be more or less concentrated by convexities; but we may rest assured

that healthy vines will not be injured by the sun's rays passing through plane glass, if sufficient ventilation is afforded.

The size of a vinery must be determined in a great measure by the means at command, not only as regards the first cost of erection, but also that of future keeping and management. We have seen a considerable amount of produce in a very small house, not more than 10 feet long, and scarcely so much in breadth, and in such a space it is possible to ripen well 50 lbs. of grapes, and even more than that with good management. With ample means, on the contrary, the length may extend to hundreds of feet in one range; but the range ought to be divided by glazed partitions, and in no case should any division exceed 50 feet in length. By means of these divisions we can give the proper treatment to early or late crops, as well as to kinds requiring much or comparatively little heat. The width need not exceed 15 feet, and this will admit of nearly 20 feet of training.

The height of the front wall is the next consideration. Where there are no upright front sashes, the front wall should not be more than 1 foot above the level of the border, making allowance for this being raised above the general level of the surrounding area. If there are front sashes, they should not be high, otherwise the extent of surface for training the rods is diminished. The height of the back wall depends entirely upon the width of the house and the angle which the roof is to form with the horizon. This should be considered with reference to what has been stated on that subject; it may be from 30° to 34° for the general crop in the south of England, and near London, and a degree more for every degree of latitude further north; for very early forcing it may be 40° . It is advantageous, we may also observe, to carry up the back wall to at least 18 inches above the glass, and the French recommend even 3 feet.

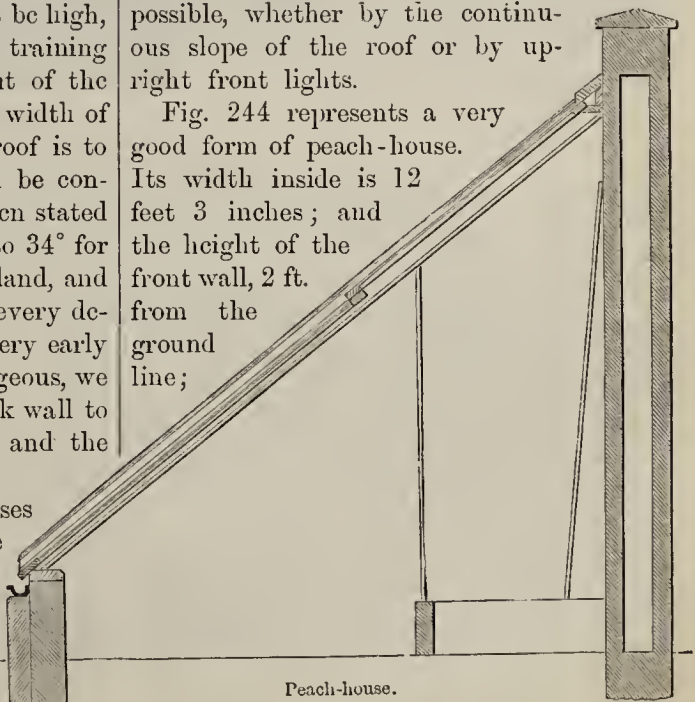
Peach-houses.—Formerly peach-houses were constructed very narrow, the glass being nearly upright, and it was necessary that they should be so, otherwise the trees, which were generally planted against the back wall, would have been too far from the light. Now, however, the trees in first-rate houses are planted in front and trained to a trellis, about 1 foot from the glass, and parallel to it; and this being the case, all parts of

the tree, so far as the trellis extends, enjoy an equal share of light, and the width of the house does not require to be so limited. A lean-to house, having a width of 12 feet, and about 10 feet height of back wall, will give a length of 15 feet for training. This is quite enough of extension for the branches of a vigorous tree, and several years must elapse before the whole of the trellis can be covered. This may, however, be done in shorter time by planting trees with tall stems in a well-prepared inside border, so that their branches may extend under the upper half of the roof, while the lower is being furnished by the trees planted in front. Or, as a few well-managed peach trees in front will afford an ample supply for a moderate family during the time the fruit can be kept, the upper part of the roof may be occupied by vines planted at the back wall and trained downwards, taking care to stop or turn aside the leading shoots before they interfere with the extremities of the peach shoots.

For very early forcing, the trees ought to be planted inside; accordingly the front wall of a peach-house should be on arches, in order that, if planted inside, the roots may have liberty to extend outwards; and the glass should reach as near the ground as possible, whether by the continuous slope of the roof or by upright front lights.

Fig. 244 represents a very good form of peach-house.

Its width inside is 12 feet 3 inches; and the height of the front wall, 2 ft. from the ground line;



the height of the back wall from the ground line, twelve feet four inches to the lower side of rafter, and from above the rafter to the coping fourteen inches; the path at back is

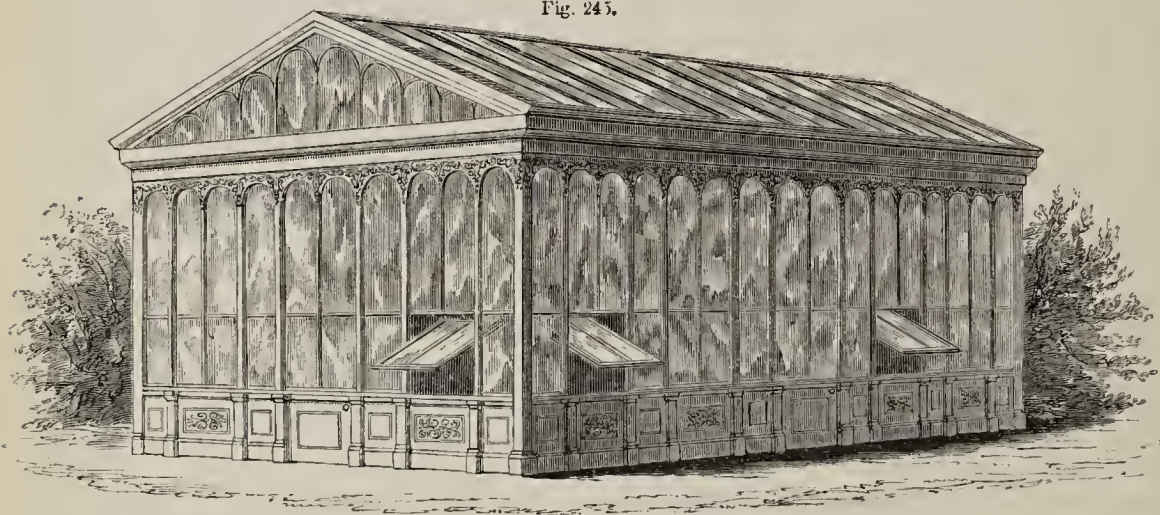
raised 14 inches above the ground line. The roof is at an angle of 40° elevation; so that the structure altogether is well adapted for the early forcing of either peaches or vines.

Cherry-house.—The form of structure most suitable for forcing cherries depends on whether the trees are planted against the back wall, or in pots. In the former case, the house should be narrow, in order that the vegetation of the tree may have the advantage of being near the glass. If the trees are in pots, a wider house will be more economical, as it will, as compared with a house of narrow form, contain more plants under the same extent of glass.

Whatever may be the form of the house,

ample ventilation should be provided; for the cherry requires abundance of air at all times, and more especially at the blossoming season. As it is not necessary to keep the temperature so high as for vines and peaches, the difference of expense for heating a span-roofed house for cherries, as compared with that of a lean-to, will not be great; and as houses constructed in the former manner admit light on all sides, they may be considered very proper for forcing cherry trees in pots. To afford head room over the whole area, the house should be constructed with upright sashes 4 feet high, and these ought to be hinged or made to slide past each other, so as to give ample means of ventilation. Plums

Fig. 245.



Gray's Conservatory.

and apricots may be forced in the same house with cherries, or in a separate one of similar construction.

Fig-house.—A narrow lean-to, with a flow and return hot-water pipe, answers very well for figs trained against a wall. A span-roofed house, such as that above mentioned for cherries, will be proper for the pot culture of this fruit; or in such a house figs may be planted out in a border having a chalky subsoil, either natural or artificial.

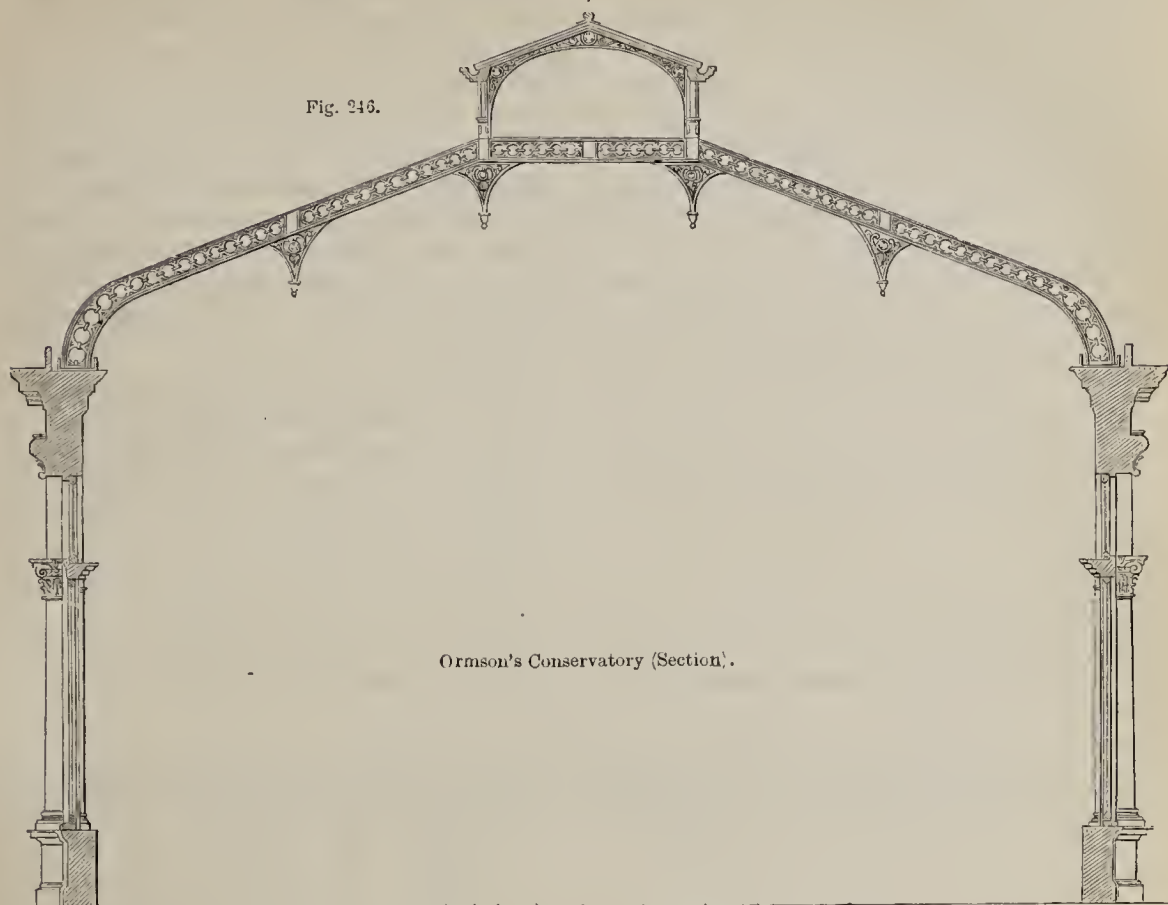
Greenhouse and Conservatory.—The size and form of these are exceedingly variable. The former often depends on the means at command; the latter on the taste of the proprietor. In many cases they are constructed so as to harmonize as much as possible with the style of the mansion. Formerly they were built with upright glass in front, no light being admitted by the roof, back, or ends, and even much of the frontage was occupied with

too massive architecture to permit sufficient light to reach the plants; but such as it was the plants inclined towards it, and their growth was what is termed *one-sided*. The importance of light for vegetation has of late years become better known than formerly, and great improvements have accordingly been made in the construction of greenhouses and conservatories. Instead of dark roofs very light ones are constructed; and plants can now be grown fit to be seen on all sides.

The lean-to form is very generally adopted in the case of very small greenhouses, advantage being frequently taken of a wall already built. In such, plants may be grown very well, but not so symmetrically as in span-roofed structures, or others that admit light on all sides of the plants. To do this should be the aim as much as possible in all greenhouses and conservatories; and with this in view, and with the means of admitting plenty of air, any form

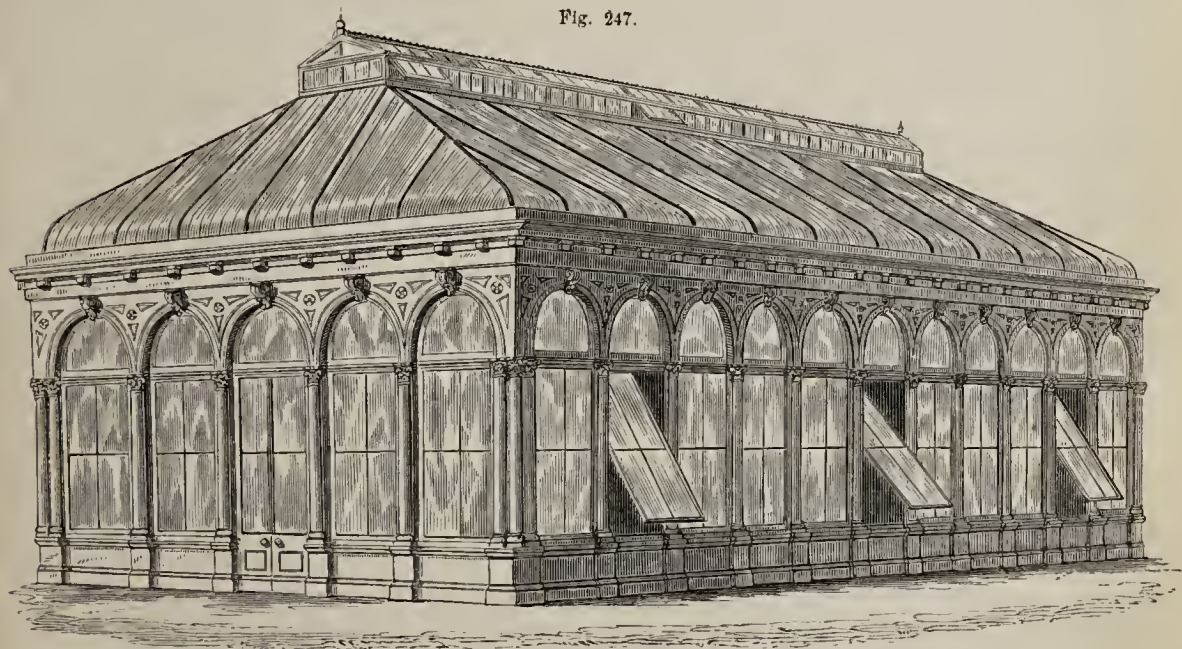
may be adopted according to circumstances. | built by Mr. Gray, of Danvers Street, Chelsea,
The greenhouse or conservatory (Fig. 245). | and exhibited by him at Chiswick, in June,

Fig. 246.



Ormson's Conservatory (Section).

Fig. 247.



Ormson's Conservatory.

1858, is well adapted for the growth of plants, | those of the span-roof. The former prevents
and, on the whole, in very good taste. It | the plants from being injured by sudden
combines the advantages of the back wall with | changes of temperature, while the span-roof

permits the light to fall on the foliage to a considerable extent from the back as well as the front; and abundance of light is admitted by the roof, front, and ends.

Fig. 247 represents a splendid conservatory, exhibited at the same time as the above, by Mr. Ormson, of Stanley Bridge, King's Road, Chelsea. It is 60 feet long, 30 feet wide, and 14 feet high to the eaves. The sides are composed of wood and glass, the roof of iron and glass. The rafters (seen in the section, Fig. 246) have a light appearance, from the ornamental perforations; and altogether the structure exhibits an architectural and very elegant design, presenting a wide contrast with the architectural conservatories of the last century, a period which we must include as part of the dark ages in regard to large plant structures.

Orangery.—By this is understood a house in which orange trees are kept during winter, when they will exist without much light, their vegetation being then comparatively inactive. That being the case, orangeries were generally constructed in an architectural style, with a ceiled roof, light being only admitted by large windows in the front and ends. In a horticultural sense, such buildings can only be termed places of shelter, for except near the glass no perfect growth could take place. Now, merely for the purpose of shelter, it is scarcely worth while to be at the great expense of an architectural building, when perhaps for the same money, or very little more, a greenhouse or conservatory could be erected, in which plants could not only be preserved in winter, but made to flourish at that and all other seasons. If any intelligent gardener were required to grow orange trees to the greatest perfection, he would not choose a dark-roofed house for the purpose; therefore, we may consider the term *orangery*, such as it was understood to be by gardeners and architects, as now obsolete.

Stove.—Of structures in which plants from the hottest parts of the world are grown, there are two kinds, distinguished as the *dry* and the *moist* stove; but either may be rendered dry or moist, according as water is freely supplied, or the contrary. The principles by which the construction of stoves should be regulated, have reference to the three great agents of vegetation—heat, light, and moisture—principles which ought, in fact, to be kept in view in the construction of all plant

structures. The stove differs from the greenhouse chiefly as regards heat, for which in stoves more ample provision requires to be made, and that not only as regards top, but likewise bottom heat. A greenhouse may be made a stove by supplying bottom heat and increasing top heat; and, on the contrary, by withdrawing the former and diminishing the latter, the stove may be made to serve the purpose of a greenhouse. Indeed, for many plants for which the greenhouse is too cold, and the stove too hot, an intermediate house is desirable.

Bottom heat for stoves is sometimes supplied by means of tanners' bark placed in a pit in the body of the house, and on this the pots containing the plants are set, or occasionally plunged in it, to a greater or less depth, as when it is necessary to excite their roots more than their tops. But generally a fair share of bottom heat is maintained by placing the pots on slate or stone, under which there is a heated chamber, whether by flues, hot-water pipes, tanks, or heated air; but hot-water pipes are the most eligible.

Wall-frames.—In the south of England, wall-fruits, such as peaches and nectarines, ripen perfectly well without the aid of glass in ordinary seasons, the only protection required being that against late spring frosts; but in the northern parts of the kingdom more is requisite, and accordingly walls are sometimes covered with glass, forming, in fact, a narrow house, which may be termed a *wall-frame*.

Colonel Challoner's frame is constructed on very good principles as regards ventilation; and it answers the purpose for which it is intended exceedingly well, but it is thought to be rather expensive. In this, brackets support short sashes about $2\frac{1}{2}$ feet long, hinged to a bar below the coping, and sloping so as to throw the wet over the top of the front sashes. T-irons, so called from their section resembling an inverted T, support sashes in front of the wall at an angle of about 75° , and which reach to within $2\frac{1}{2}$ feet of the ground. Between the latter, and where the lower ends of the sashes rest, there are sheet-iron flaps for the purpose of ventilation; and air can also be given at top by raising the hinged sashes. This is effected without weights by means of a quadrant arm, and the facility with which air can thus be given is of great importance.

There are many other ways in which wall-

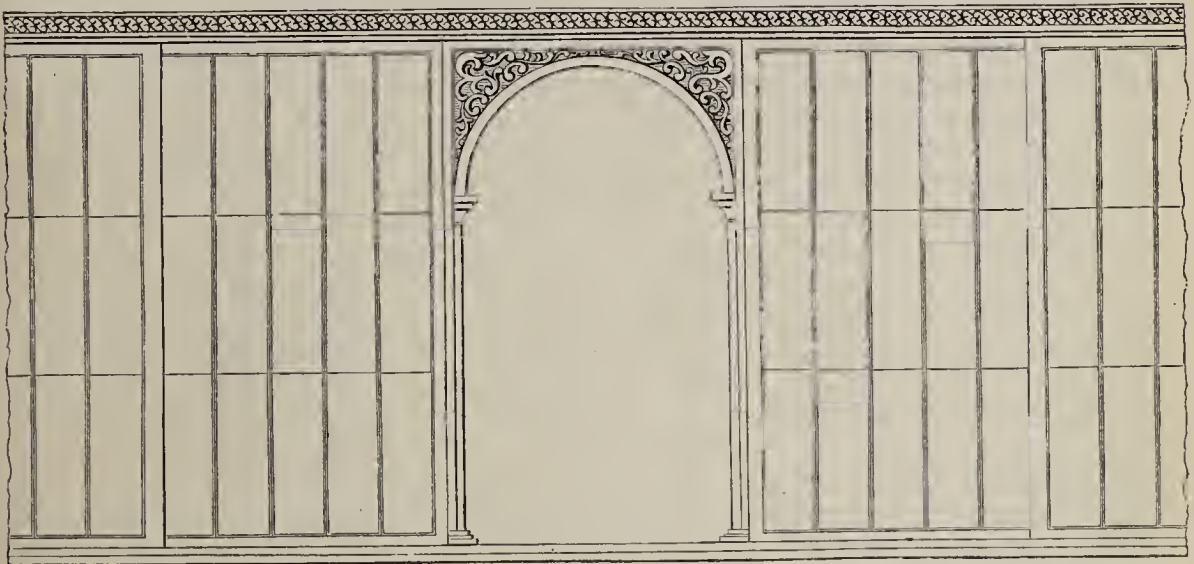
frames may be constructed, but many of them are more expensive than lean-to structures, of the character of which they more or less partake, and are nearly, if not quite as costly as these. In many cases we think it would be better to go to a little more expense and have a command of heat.

The following, however, would be a very simple mode of constructing a wall-frame:—Let rafters be formed of deal 2 inches thick, and 6 or 7 inches deep, more or less according to their length, this depending on the height of the wall. These can be secured at top to a wooden plate, bolted to tubes fixed in the wall, such as we have previously recommended, and the bolts on passing through the tube to the other side of the wall could there be tightened by a nut. At bottom, the rafters might be secured to a plank furnished with cast-iron sockets or shoes. The rafters, although only 2 inches thick, will, notwithstanding, admit of sufficient hold for the side bars of the sashes to slide upon in giving or reducing ven-

tilation; or, if the side-bars of the sashes were made somewhat stronger than usual, and if they had plates of stout hoop, 3 inches broad, screwed on the outside, they would not swerve if used without rafters, even if made 10 feet in length. They could be glazed up to a cross bar 3 feet from their tops, and all above this might be constructed so as to be moveable on hinges or pivots attached to the top of the sash, to permit of air being given. A wall could be more readily covered by sashes of this description than by any other that we are aware of. The sashes would only have to be placed closely side by side, and fastened in case of strong winds, and when not required they could be as readily removed and employed for other purposes. With little more expense, the top of the sashes might abut against a rail, 18 inches from the wall, and the intermediate space at top could then be glazed so as to form either a fixed or a moveable roof.

Glass Walls.—Several of these (Figs. 248 and 249) have been erected in different parts

Fig. 248.



Ewing's Glass Wall.

of the country, but their adoption has been but partial, the expense being great in proportion to the area inclosed. On the other hand, the vegetation within them has the advantage of being near the glass; but the greatest drawback is the little protection they afford compared with a lean-to structure, which might be put up for the same, or perhaps less expense. Glass and iron radiate heat so quickly that in a sharp frosty night the small quantity of air inclosed by them in the inte-

rior of the wall is soon cooled down to within a few degrees of the temperature of the external air, therefore the property of protecting from frost cannot be urged in their favour. With a flow and return hot-water pipe their utility would be greatly increased, as they could then be kept gay with flowering plants; and such things as peaches, vines, &c., could be brought to good perfection in them; but it would then be necessary to make the width greater, as, in fact, has been proposed by Mr. Ewing him-

self. They might also be introduced in particular situations where something is required to hide a bad view, but where also a solid wall or a house would be unsightly.

III.—HEATING

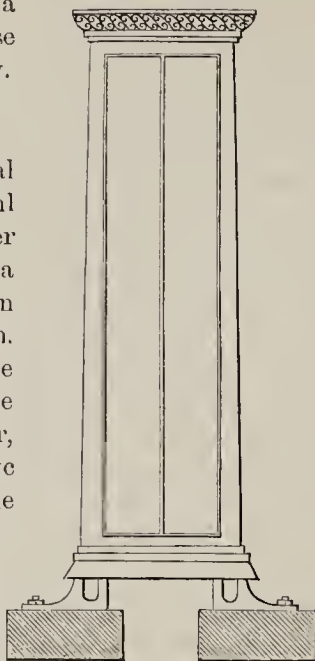
For horticultural purposes, artificial heat is derived either from substances in a state of fermentation or of combustion. The former will have to be noticed in the succeeding chapter, and therefore we shall here confine ourselves to the latter. For combustion, wood is sometimes used, but in most cases coal—either as it comes from the pit, or reduced to coke—is the substance employed. The chemical constituents of *mineral* coal are, according to Richardson and Regnault—Carbon 24, hydrogen 13, and oxygen 1; and, on the authority of Liebig, the composition of *coking* coal is—Carbon 20, hydrogen 9, and oxygen 1.

- 1 lb. of mineral coal will melt $62\frac{1}{2}$ lbs. of ice.
(Watt, Tredgold.)
1 lb. of charcoal will melt $96\frac{1}{2}$ lbs. of ice.
(Lavoisier and Laplace.)
1 lb. of hydrogen will melt $295\frac{1}{2}$ lbs. of ice.
(Lavoisier and Laplace.)
1 lb. of hydrogen will melt 320 lbs. of ice.
(Dalton.)

From the above data we may form an approximate estimate of the relative heating values of the carbon and hydrogen constituents of coal. Accordingly, the heating effect of the carbon may be roughly estimated at $\frac{2}{3}$, and that of the hydrogen at $\frac{1}{3}$. The importance of the latter ought, therefore, to be borne in mind, in order that furnaces may be adapted for its combustion, otherwise the loss of fuel would be very great—upwards of 30 per cent.

Fuel of any kind requires to be heated to a certain extent before it will ignite. Many are aware that a live coal will not burn a thin handkerchief strained over a cold iron. This simple experiment shows how rapidly the metal abstracts the heat from the live coal, so

Fig. 249.



Ewing's Glass Wall (End View).

much so that the thin fabric of the handkerchief has not time to acquire the temperature necessary for ignition. When fuel does ignite, combustion proceeds with greater or less rapidity, according to circumstances; and that process having been completed, a certain amount of heat must have been produced, and the question is, What becomes of it? The heat generated by the combustion of the fuel is transferred by contact or by radiation, or in both ways, to other bodies, which receive it in different proportions, according as they are naturally adapted for the absorption of heat, and according as they are more or less exposed to the direct action of the fire. We sometimes hear of an apparatus doing much work with a very small quantity of fuel, but to this there are limits, for evidently no substance can receive from another a greater amount of heat than the combustion of the latter affords. This is the extreme limit beyond which nothing can be expected.

Heat has a constant tendency to equalize itself; hence, when combustion ceases, the substances which have acquired an elevation of temperature begin to cool, their heat being communicated to other substances near them, and from these to others more and more remote, till at last the original intensity becomes, as it were, universally diffused. It may be communicated from one steadfast solid body to another, or it may be conveyed to a distance by air or water in motion.

By employing air or water as a vehicle for heat, we can convey it to a considerable distance from the fireplace, in either a perpendicular or horizontal direction, or in that of any upward incline, but not readily downwards, because it is the nature of gases and liquids to ascend as they become heated.

Of the two principal modes of warming horticultural structures by fire heat, that by which air or other gases in motion is the vehicle or heat-carrier, is the oldest; the other, by which water in motion is the medium of conveyance, is the most approved, and that which is now generally adopted.

The Flue System.—The flue is a cavity commencing at the furnace, of which it may be said to be a continuation, and terminating in the chimney. It incloses the heated air and gases, conveying them generally along the front and then the back of the house, by which time most of their heat is imparted to the materials of the flue, and from these communicated to the air of the house.

Although the new system of heating by hot water has superseded in a great measure that by the old flue, as it is now frequently designated, yet, when well constructed, flues answer the purpose exceedingly well, as has been proved by the fine productions which have been obtained in houses so heated. The house in which Mr. Cock, of Chiswick, grew his pælagoniums, was not heated by hot water, but by a flue, and the plants, for healthy foliage and fine bloom, were unsurpassed. In that flue-heated greenhouse, plants were grown that successively obtained the highest prize at the London exhibitions for a series of years. With such facts on record it must be admitted that well-constructed flues may still be successfully employed for horticultural purposes.

By a flue, heat from the furnace is distributed, by being mostly transferred to a comparatively large extent of surface, with which the air of the house is in contact. Previously, this air may have been comparatively at rest, but as soon as the flue gets heated, the air next to it is warmed, rarified, and consequently ascends; and thus, whilst the air within the flue is a carrier of heat in a horizontal direction, that outside the flue conveys it in a perpendicular direction, or as nearly so as the form of the house will permit. When, as above stated, the air in contact with the surface of the flue becomes heated and rendered lighter, it immediately ascends, but at the same time its place must be instantly occupied by air that is colder and heavier, and this in its turn becomes heated and ascends. A circulation of the air in the house is thus induced, and it is continued as long as the heat of the flue is maintained. Flues, then, effect a distribution of heat, and at the same time a circulation of air. Where there is a heated flue, the air of a house cannot remain stagnant.

As heated air naturally moves upwards, it follows that flues have most command of heating the whole atmosphere of a house, when they are situated near the lower angle. The upward tendency of the air is such, that it conveys the heat from the lowest part of the house to the highest, so as to render this generally hotter than the middle portion, although farther than the latter from the source of heat. In the last century, the upward tendency of heated air appears to have been overlooked in the construction of hothouses, for in Miller's *Gardener's Dictionary*, edition 1768, a stove is

represented, in which there are four flues all at the back wall, and above each other, but none in front. To this part heat could not be carried by the air, for when heated by the flue at back, it could not descend to the front, as the warmer and lighter air could not displace the colder and heavier. The front of a stove with such an arrangement of flues could only derive heat from them by radiation, and the intensity of heat in that way diminishes inversely as the square of the distance from the radiating surface. Supposing that surface to be the back wall, and the temperature there to be 160° above that of the external air, and if in the middle of the house the heat were 40° above that temperature, then at the front it would only be 10° higher than outside. Presuming that 40° above the external temperature was the required temperature of the air throughout the house, the front, heated only by radiation from the back, would be 30° colder than it ought to be. This shows, that in order to distribute the heat throughout the house, we must not depend so much on direct radiation as on the movement of the air in the manner above pointed out.

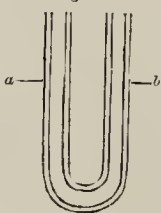
The flue should pass along the front, and then return, at a somewhat greater elevation, near the middle. In some very small greenhouses it may be sufficient to carry the flue across one end from the fire, along the front and farther end, to a chimney in the back wall. The space occupied by flues is not lost, for many things requiring bottom heat can be placed over them, on a temporary stage, or upon inverted flower-pots, so as to receive no more than the proper degree of heat. The furnace should be placed 1 or 2 feet lower than the level of the front flue, and from the furnace to this level the flue should gradually ascend. Flues should not turn either vertically or horizontally at right angles. There should not only be a gradual ascent from the furnace, along the end, but also for a very short distance in the front. Flues are very apt to crack, or sometimes to burst at or near the corner where they take the front direction, but if the corner is rounded off, and the upward slope continued on a little way in front, the draught of heated air will sweep along with less interruption; and whilst the rest of the flue receives more heat, that part will receive less, and of course will not be so apt to crack. Nevertheless, it would be well to use fire-bricks along the end, and for several

feet along the front. There are now excellent materials for the construction of flues, to be had in pieces several feet in length, so that few joints will be necessary; and they may even be obtained in a tubular form and joined like pipes. But many persons may have only common bricks at command. In that case hoop-iron may be employed to bind the sides lengthwise, and pieces of sheet-iron, about 3 inches broad, should be bedded in mortar, beneath each joint of the covers. It is necessary to observe that the iron should be wetted, so that it may rust a little, and then the iron and the mortar will adhere to each other. Pieces of thin slate will answer very well for the same purpose, if imbedded in the mortar, for if the slate should crack in the middle, still the mortar will hold the pieces closely together. When the flue returns as far as the part coming direct from the furnace, it should be built on the top of that part, and it will then have a better draught.

Flues should be well cleaned every season, before they are set to work, for when coated with soot, they neither draw so well nor absorb the heat so readily, and if they do not take in the heat well, they cannot give it out well; therefore facilities for cleaning should be kept in view when the flue is being constructed. If flues are not heated for a considerable time after they are built, they will not be so apt to crack. Small cracks may be stopped with a mixture of clay and cowdung.

Heating by Hot Water.—If a pipe, open at both ends, is bent in the form of an U (Fig. 250), and water is poured in, it will stand at the same height in both legs, as at *a b*; but if the water is taken out of the leg *a*, and spirits of wine substituted, the water will fall below *b*, and the spirits of wine will rise above *a*, presuming that the two liquids were kept separate; consequently the height of the two columns will be unequal, because the weights of the two liquids are unequal, the pure spirits of wine being, bulk for bulk, nearly one-fourth lighter. Now, although water of an equal temperature would stand at the same height, yet if cold water were put in the one leg and hot in the other, the heights would be unequal, because cold water is heavier than hot; and although the greatest difference between the coldest and hottest water is less than that

Fig. 250.



between water and spirits of wine, still it is sufficient to produce an inequality of pressure. If both legs were completely filled and heat applied, say to the leg *a*, the water would overflow; but if the two legs were connected at top as well as at bottom, and one side were kept hot and the other cold, the water would constantly ascend in the warm leg and descend by the cold, and thus a circulation would be established.

Fig. 251.

Let *ab*, Fig. 251, represent a horizontal 4-inch pipe; *ac* and *bd* two upright ones, the latter having a stop-cock at *e*. The pipes may be glass, in order to see what takes place in their interior. Let pure water be poured in the leg at *c*, and simultaneously an equal quantity of coloured water at *d*, till the water in both legs stands at the respective height *c* and *e*, the coloured portion will then have extended as far as *f*; there the junction of the coloured and uncoloured portions will remain stationary, and so would any solid substance if introduced anywhere in the pipe *ab*, because it would there have an equal pressure on each side of it. Whilst the whole of the fluid is motionless in the pipes, close the cock at *e*; fill the pipe to *d*; close the opening at *c* with a valve or cover loaded with say six lbs., and open the cock at *e*; there will then be more than ten lbs. of water in the leg *bd*, against half that weight in *ac*. On removing the weight at *c*, the water will continue to overflow until that in the pipe at *d* sink to *e*, when the balance will be again restored; but in the meantime the coloured water will have moved to *g*. Instead of producing motion in the contents of the pipes by increasing the weight of the column *bd*, it might have been done by decreasing the weight of that in the pipe *ac*, we shall say one-half; then the water in *be* would sink a certain distance, the coloured fluid would move along an equal distance, the water would rise as much in the pipe *ac*; and then the balance being restored motion would cease. Supposing the water in *ac* to be rendered lighter by heat, and no longer a balance for the colder and heavier water in *be*, the latter portion will then press forward the water from *b* towards *ac*. Again, if the opening at *c* is closed, and a communication made by a pipe from *c* to *e*, the water as it is forced upwards will proceed towards *e*, and there supply the place of the water tending to move towards *ac*, and

thus a circulating motion is commenced, which will continue as long as heat is maintained to keep the water in *a c* hotter, and consequently lighter than that which is cooled in its progress to and through the return-pipe. It will now be evident that the motion of the water must proceed simultaneously *from* the boiler along the upper pipe, termed the *flow-pipe*, and *to* the boiler along the lower one, which is called the *return-pipe*. The contrary could not take place, because the heated and lighter water at *a c* could not move that of greater density in the pipes *e b* and *b a*. The primary cause of the motion is, then, the heat of the fire rendering the water in the boilers specifically lighter than that in the pipes; and when this effect takes place the law of gravity immediately comes into operation, so that the actions of flow and return are simultaneous. If, whilst the circulation was going on from *c* to *e*, the water in *e b* were heated to an equal extent as that in *a c*, the circulation would cease, because there would be as much tendency to flow from *e* to *c* as from *c* to *e*, and of course the two forces would neutralize each other. The greater the difference between the temperature of the water in the boiler and that in the return-pipe, the more rapid the circulation, and the converse.

Furnaces. — The best furnaces are those in which the fuel is most effectually consumed; it is scarcely necessary to mention that they should be adapted for a strong fire, in order to counteract intense frost; but they should also be constructed for slowly burning a small quantity of fuel, for at times only a little heat is required; and under some conditions in which fuel is placed, it will not burn in small quantity, and slowly, but will go out if not kept in a brisk state of ignition. It is well known that metals are rapid conductors of heat, and so long as they remain cold the fuel that is in immediate contact with them will not burn. The most perfect combustion takes place when fire is surrounded with slow conductors of heat, such as Welsh lumps, or other kinds of fire-brick. Tredgold, in treating of the construction of fire-places (*Principles of Warming and Ventilating*, p. 120), says, "The slowest conductors of heat should be used; some metal work is absolutely necessary, but it should be avoided as much as possible. The space for the fire and seat of the boiler it will be best to line with good fire-brick, built with fire-clay, with no more iron work about it than

is absolutely necessary; that is simply the bars, and a rim at the mouth where the fuel is put in at;" and he quotes Morveau's maxim as one that should always be kept in view, that "the fire-place should be insulated from all bodies that are rapid conductors of heat."

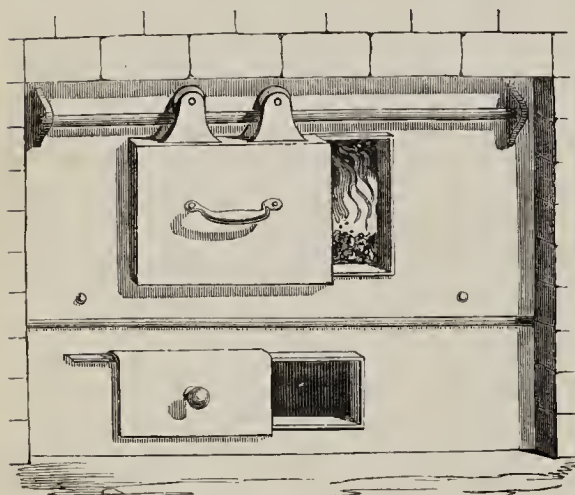
In some excellent papers on heating, published by Mr. Ainger, in the *Gardeners' Chronicle*, 1841, combustion within slowly conducting materials is one of the points which he considers of the greatest importance, and at page 683 of the same volume he recommends the fuel to be burned in slowly conducting materials, and certainly not in contact with the boiler. "Those portions of fresh coal which lie against the boiler undergo for some time distillation rather than combustion, and while they are thus wasting they intercept a large portion of the boiler surface from the central portion of the fuel, which is probably in a state of incandescence." If a fire-place were required to be constructed so as to drive off as much as possible of the hydrogen in an unignited state, the best plan would be to have the furnace-bars and sides formed of pipes with cold water constantly circulating through them. All the fuel in contact with these pipes would not ignite, but it might get hot enough to distil or drive off, unignited, the hydrogen, constituting about one-third of the heating value of some kinds of coal. But this is what ought to be saved, and the best mode of doing so is to construct the fire-place with non-conducting materials; and for the same reasons we consider metallic fire-places objectionable for horticultural purposes, more especially when they are tubular, or otherwise form a portion of the boiler.

Having pointed out the conditions under which the heat of the fuel may be most advantageously produced, we may now advert to its distribution. Once produced, it must distribute itself in some way, and the grand object to be attained is to transfer as much of it as possible to the water in the boiler. The latter ought to be set so as not to obstruct combustion, and should have a large surface directly exposed to the radiation of the fire.

The combustion of ordinary heating materials, it is well known, requires a certain amount of air. In furnaces this is usually supplied through the bars of the grating, and occasionally in part through the furnace doors. Sufficient air should be admitted to supply the necessary amount of oxygen, without which

the fuel would not burn; more than sufficient is injurious, for it robs the fire of a portion of its heat, and carries it up the chimney. It is therefore necessary to have the power of regulating the admission of air, and consequently that the furnace-door, as well as that of the ash-pit, should fit perfectly. Hinged doors are almost certain to warp. The best furnace-

Fig. 252.



Sylvester's Furnace-doors.

doors that we have seen are Sylvester's, Fig. 252. They have no hinges. The doors, which are faced with fire-brick or Welsh-lump, move on rollers on an iron rod; or they slide by a ledge in a groove, as in the lower or ash-pit door represented in the figure. The frame of the opening projects a little outwards towards the base, so that the weight of the door partly rests upon it; and the more the latter is moved the closer it fits.

By these doors the air can be regulated to a nicety; and a good stoker will soon find out from experience how much opening he should allow. If he require much heat he must increase the quantity of fuel, and in proportion the supply of air.

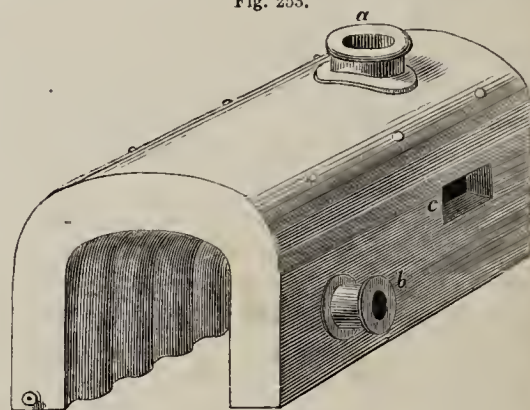
Boilers.—Of these there are many kinds, and some very complicated; but of any two that may prove equally effective, the simpler is, of course, to be preferred. No complete set of experiments has yet been carried out in order to test the heating power of different constructions of boilers, nor the amount of work which they will respectively perform with a certain quantity of fuel; but from what we have observed, we have come to the conclusion that the simplest form is the best. Until there be proof to the contrary we should

be inclined to give the preference to the horse-shoe or saddle form of boiler, with a pretty large surface for the fuel to act upon in the first instance. Instead of that, the surface which presents itself to the direct action of the fire is in many cases small in comparison to the secondary or auxiliary surfaces. Mr. Ainger advises that care be taken to receive as much heat as convenient in the shape of radiation, and to depend as little as possible upon the smoke and gases, which may carry a large portion of their charge into the chimney before it can be abstracted. Dr. Arnott does not approve of boilers which present only a comparatively small surface to the direct radiation of the fire, for this he considers the principal one for heating effect; all others over which the draught may be conducted he terms auxiliary surfaces.

The plain saddle boiler is well known, and if properly set over a fire-place of which the sides and back are formed of fire-brick or Welsh-lumps, its working may always be safely depended on.

Fig. 253 represents a modification of the saddle boiler, the inside being corrugated; *a* is the flow, *b* the return, *c* an opening for the escape of smoke, another similar being oppo-

Fig. 253.



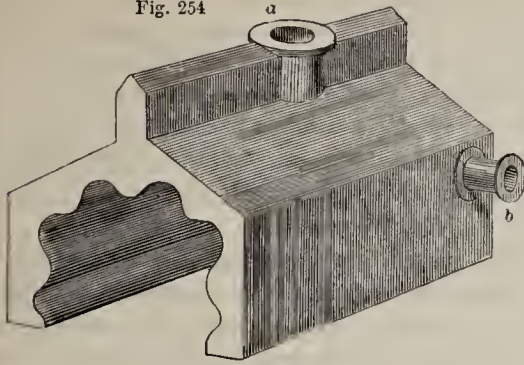
Gray's Boiler.

site, on the other side. The water circulates all round the arch, and also in the farther end, which is closed, and serves to rebut the flame.

Lobjoit's boiler, invented by Mr. Lobjoit of Turnham Green, is represented by Fig. 254. It is corrugated longitudinally, but, independent of this, it presents a large heating surface to the direct action of the fire; *a* is the flow-pipe, *b* the return one. The water circulates within the upright sides, the straight sloped roof, and the ridge at top. Slabs of fire-brick material surround the boiler on the two sides,

and one is placed against the farther end. Other slabs rest on the sides and against the top of the ridge, thus forming a return flue.

Fig. 254

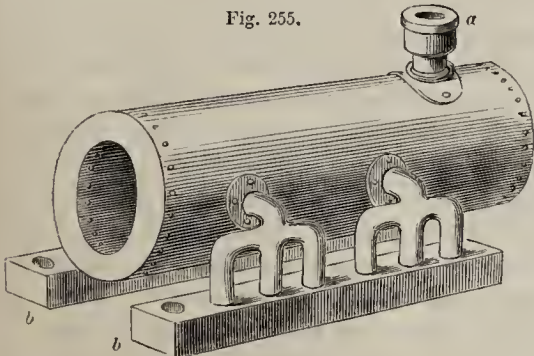


Lobjoit's Boiler.

The frame of the furnace-doors is secured close to the boiler by hooks fixed to each of the sides of the boiler. This boiler might be improved by inserting the return pipes nearer the bottom; it would then be highly worthy of recommendation.

Monro's Cannon Boiler is represented in Fig. 255, where *a* is the flow, *b b* the return

Fig. 255.



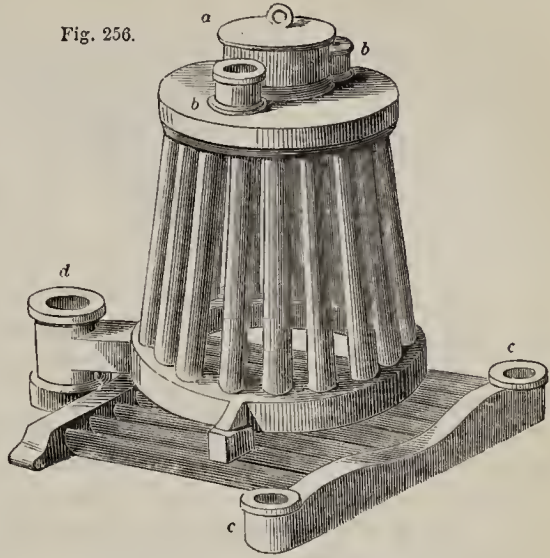
Monro's Cannon Boiler.

pipes. It has the advantage of affording plenty of space below it for the fire; but we are doubtful whether a plain saddle boiler, presenting the same extent of surface more directly to the action of the fire, would not answer quite as well, if not better.

Fig. 256 represents *Ormson's Patent Jointless Tubular Boiler*, in which *a* is the feeder, *b b* flow, and *c c* return pipes, and *d* the communication between the horizontal and upright tubes. The former serve the purpose of fire-bars, but we should prefer burning the fuel in a place expressly adapted for perfect combustion. However, the boiler in question is a powerful one, and being without joints is not subject to leakage, as is sometimes the case when tubular boilers are composed of parts joined by means of iron cement.

Corrugated boilers have been recommended on account of their presenting a larger surface to the action of the fire. This must be ad-

Fig. 256.



Ormson's Patent Jointless Tubular Boiler.

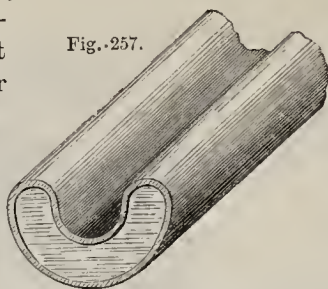
mitted; but at the same time they afford lodgments for soot, a disadvantage by which all that is gained by a greater surface is liable to be counteracted. Besides, if we want more surface we can easily obtain it by getting a plain boiler of a somewhat larger size.

With regard to the proper size of boilers there is considerable diversity of opinion. Mr. Ainger gives the following general rule:—"Take the cubic contents of the house, and for half-hardy plants give to every 100 feet 10 square inches of boiler-surface, and 1 square inch of fire-grate. For tropical plants double these proportions, and for forcing-houses take intermediate proportions according to the temperature required."

Pipes are generally made of cast-iron, but other materials are sometimes employed. Copper pipes are much used in France, and they have the advantage of heating quicker than those of cast-iron; but, on the other hand, they sooner become cold if the fire is not kept up, and this is often a disadvantage. Earthenware pipes have also been employed; and with vulcanized india-rubber they may be joined so as to answer, but for substantial apparatus, cast-iron is to be preferred.

The cylindrical form is most readily obtained, and altogether it is most to be recommended for ordinary use, but at more expense any other form may be adopted; in particular cases the pipes may, for the sake of appearance, be made to resemble a plinth. They are

also frequently cast with a cylindrical bore, but with a pan or trough on the upper side for water to supply moisture. Fig. 257 represents a pipe circular below, but hollowed above for water. Its capacity is less than that of a 4-inch pipe, but the surface which it presents is at least one-fourth more.



Eley's Patent Fluted Pipe.

It is new, but we think it will be found to answer well. The usual diameter of round pipes is 4 inches, and this being found to be the most convenient and efficient size, calculations for length of pipe are usually made according to that diameter. In the case of small structures, 3-inch pipes are often used on account of their occupying less space.

The pipes, whatever may be their size and form, should be of uniform bore or capacity; and, where stop-cocks are employed, they should be so constructed as to afford, at pleasure, a clear water-way equal to that of the pipes. Contractions and bends tend to obstruct the circulation; the former may be avoided, and of the latter there should be as few as possible. It sometimes becomes necessary to dip under a path or over a doorway, and in that case the flow-pipe should rise as high above the level of the boiler as the dip is below it, and it is not advisable to have more than one such dip in the course of the circuit; and if that one has a considerable length of pipe between it and the boiler, so much the better. It is necessary that a small tube should be inserted at the highest part of the flow-pipe, in order to provide for the escape of air which may there collect; indeed, there should be one at every downward bend.

To allow for expansion and contraction, the pipes should be slung or otherwise supported in a manner that will permit them to accommodate themselves to these forces. According to the experiments of General Roy, cast-iron expands $\frac{1}{817}$ between the freezing and boiling points of water, or about $1\frac{1}{3}$ inch in 100 feet.

With regard to the joints of pipes, some prefer those which are flanged, for which vulcanized india-rubber answers well for screwing up against; others socket joints. The latter occupy less space, the former can be more

easily removed and replaced. Except near the fire, socket joints need not be put together with iron cement, especially when the circulation is carried on nearly on a level. When well caulked with rope and a mixture of red and white lead, we have not, in many years, observed a single failure. By kindling a fire under the joints so secured, the pipes, if wanted elsewhere, can be removed without breakage, which can rarely be the case when iron cement is employed.

The quantity of pipe requisite for heating a house must depend on the size and form of the latter, the quantity of glass, and whether the roof is of iron and glass, or of wood and glass.

Tredgold finds, in the first place, the number of cubic feet of air to be heated per minute. This, in the case of greenhouses and other structures where the difference between the temperature of the house and that of the external air is not more than 30° , he estimates to be equal to 5 times the length of the glass of the roof in feet, added to $1\frac{1}{2}$ times the whole area of glass in feet, added to 11 cubic feet for each door. But for stoves and forcing-houses, where a more elevated temperature has to be maintained, he gives the following rule:—"To the length of the stove in feet, multiplied by half the greatest vertical height in feet, add $1\frac{1}{2}$ times the whole area of glass, and also 11 times the number of doors; the sum will be the number of cubic feet to be heated in a minute from the temperature of the external air to that of the stove." From the sums obtained in the above ways a deduction of one-tenth was made in the case of houses with wooden rafters. Then "if the cubic feet of air to be heated per minute be multiplied by the number of degrees it is to be warmed, and the result be divided by twice the difference between the temperature of the house and that of the surface of the pipes, the result will be the feet of iron pipe, &c., required. Thus, if 1000 cubic feet per minute are to be warmed, and the extreme case is supposed to be, that when the external air is 20° , the house should be 50° , and therefore the air is to be warmed 30° ; and with water, the surface will be 190° when the water boils, but only 180° in the average state. Therefore,

$$\frac{1000 \times 30}{180 - 50 \times 2} = \frac{30,000}{260} = 116 \text{ feet of surface.}''$$

—*Hort. Trans.* vol. vii. p. 578.

Mr. Hood, from longer experience, calculates the quantity of air to be warmed per

minute at $1\frac{1}{4}$ cubic feet for each square foot of glass, deducting, as a general rule, $\frac{1}{8}$ for wood work; and he gives the following rule for ascertaining the length of pipe which will be necessary for warming any given quantity of air:—"Multiply 125 by the difference between the temperature at which the room [or hot-house] is purposed to be kept, when at its maximum, and the temperature of the external air; and divide this product by the *difference* between the temperature of the pipes and the proposed temperature of the room; then the quotient thus obtained, when multiplied by the number of cubic feet of air to be warmed *per minute*, and this product divided by 222, will give the number of feet in length, of pipe 4 inches diameter, which will produce the desired effect."—(Hood on *Warming Buildings by Hot Water*, page 117.)

The following table, abstracted from one in the same valuable work, shows the quantity of 4-inch pipe which will be sufficient to heat 1000 cubic feet of air per minute to from 45° to 90° , the temperature of the pipe being 200° :—

Temperature of External Air.	Temperature at which the House is to be kept.									
	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
10°	126	150	174	200	229	259	292	328	367	409
20	91	112	135	160	187	216	247	281	318	358
30	54	75	97	120	145	173	202	234	269	307
32	47	67	89	112	137	164	193	225	259	296
40	18	37	58	80	104	129	157	187	220	255
50	...	...	19	40	62	86	112	140	171	204

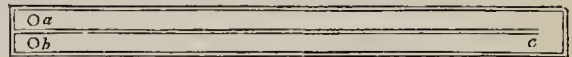
To use the above table, look for the lowest external temperature in the left-hand column, and at top for the highest temperature at which the house is required to be kept, and where the two columns intersect will be found the number of feet of 4-inch pipe which will heat 1000 cubic feet of air per minute to that degree.

High-pressure Hot-water Apparatus.—This consists of a coil of small pipe placed in a furnace, from which the piping is continued round the house, and on returning, is joined to the bottom of the coil, thus forming an endless pipe. The external diameter of the pipe is 1 inch, its bore $\frac{1}{2}$ inch, and it consists of several pieces, which are screwed tightly into each other. Connected with the highest point of the pipe, there is what is termed an expansion pipe, a tube of larger diameter, closed at top, but having near its base an opening, by means of which the circulating pipe can be filled with water. When this has been done,

the opening is hermetically closed by a screw. The object of the expansion pipe is to allow for the expansion of the water when heated, and except in it there is no space for steam; the consequence is, that the water becomes excessively heated, generally to 350° ; sometimes, it is said, to 500° , and the pressure upon the pipes is, according to Hood, from ten to twenty-four times that usual in high-pressure boilers. The apparatus, therefore, cannot safely be employed in gardens where regular attendance could not be afforded; and strong as the pipes are, we have known them to fissure and the apparatus to explode. Besides, with pipes heated to such a degree, the air must be parched and rendered injurious to vegetation.

The Tank System.—In this there is an ac-

Fig. 258.



tion of flow and return on the same principles as those by which circulation is induced in hot-water pipes. The apparatus is very simple. Let Fig. 258 represent a long shallow box, divided longitudinally as far as *c*. From the top of a boiler, let a pipe communicate with one of the divisions, as at *a*, and from the bottom of the boiler let a pipe open into the other division at *b*, and, as regards the principle, the apparatus is complete. The hottest water flows by the pipe inserted in the top of the boiler, into the tank at *a*, and simultaneously its place is supplied by colder water descending through the pipe *b*, and entering at or near the bottom of the boiler. The flow and return portions may be in one trough, with a division as above, or separated, conducted round the house, or in any other position, so as they are upon the same level, and communicate with each other at the end farthest from the boiler.

Tanks or gutters have been formed of cement, earthenware, cast iron or other metal, and even of wood. Roman cement is acted upon by the hot water, so that its cohesive properties are destroyed, for after some time a quantity of it is found in the state of mud in the bottom of the tank. Among the many kinds of cements recently discovered, there are some that will not prove so objectionable in this respect. Earthenware will answer if the joints can be made secure; and if some kinds of it are too porous, they may be satur-

ated with tallow. Wood, being a slow conductor, does not give out the heat readily enough, but, made wide and covered with slate, wooden troughs answer tolerably well in certain cases. Metal is the most substantial, but it is expensive, and the question is, Whether, instead of metal tanks, hot-water pipes had better be employed? The latter have the advantage of affording a dry heat when that is desirable, and with the addition of evaporating pans, as much moisture will be insured as can be required. In iron tanks containing hot water and air, the waste of metal is excessive, and the accumulation of oxide of iron in one year is astonishing, while in pipes filled with water, and closed from the access of air, there is very little. The tank system may be employed for bottom heat, or where much moisture is required, and, with cheap materials, it may sometimes be conveniently applied as a temporary means of heating, and, in severe weather, as an auxiliary to other apparatus. In tanks, as in hot-water pipes, the water-way should be of uniform capacity. We have seen cast-iron tanks in the form of oblong boxes, secured end to end by screws, which were hollow for the passage of the water; but the circulation was impeded at each connection, and it tended to take a direct course from one hole to the other throughout, thus leaving the water at the sides cool and quiet, so that it was long before heat was given out from them.

Heating by Steam.—This mode of heating is now almost entirely superseded by that of hot water, which is cheaper, more easily managed, and can readily be applied on a small scale; yet it has proved effective in heating some of the largest horticultural structures in the world, for example, those at Kew and Chatsworth. Pipes can be heated by steam to a much higher degree than by hot water, unless the latter is kept under pressure, but an intensely heated surface renders the air less favourable to the growth of plants than one which is only heated to 180° or 200°; and without exceeding this temperature, we can get from an easily managed apparatus, as much heat as vegetation can require. As soon as the water gets warm in a hot-water apparatus, heat begins to be communicated to the house, slightly at first, but gradually increasing, and this is precisely what is wanted, while little or no heat is obtained from a steam apparatus till the water boil. Steam may,

however, be employed to convey heat to a greater distance than could well be done by circulating water, and it is sometimes advantageously employed for heating beds of stones, which then constitute a source of steady bottom heat; or water in tanks or pipes is sometimes conveniently heated by the introduction of a steam-pipe, and occasionally steam is generated and conveyed in a small pipe for the purpose of steaming houses. In some such cases it may be occasionally adopted on a small scale; when employed on a large, a proper engineer ought to be consulted.

Heating by Hot-air Stoves is a mode now rarely adopted. To communicate heat by means of air passing over a surface heated above 212°, is allowed to have an injurious effect on vegetation. Drawing air from the coldest part of the house into a chamber heated by a stove, and then delivering it into the house, was thought good, because it combined heating with a circulation of air, this being essential to the health of plants. But that is well secured by either flues or hot-water pipes. From these the heated air must ascend to the top, and from the latter cold air must descend to take its place. This occasions a constant movement of the air in the interior of the house. According to Tredgold's calculations, a well-glazed roof will admit $2\frac{1}{4}$ cubic feet of air per minute for each foot in its length. At this rate the whole of the air of a house would be changed in little more than forty minutes. The working of hot-air stoves being precarious, and not affording any advantage over the modes of heating already noticed, further details respecting them need not be entered into.

IV.—MISCELLANEOUS STRUCTURES.

Fruit Room.—The conditions necessary for keeping fruit well, are a dry atmosphere, a cool steady temperature, and darkness. To insure these conditions as far as possible, the room should be in a dry, airy situation, and its exterior exposed to a free circulation of air; that it may have a cool temperature, the floor should have a circulation of air below it; and there should be the means of ventilation, but at the same time the doors and windows ought to fit closely in case of severe frost.

The earth at small depths has a temperature equal to the annual mean temperature of the air, which in Britain is between 46° and 50°. Now, if a room were built with double

walls and roof over a portion of ground at 50° , and if the room were closely shut up when a thermometer indicated the air inside to be as low as 32° , although for a week the air outside might continue even colder than this, yet it would be found at the end of that period that the heat from the ground-floor would have warmed the internal air from 32° to nearly 50° . It is therefore a mistake to sink into the earth for coolness in winter. Of course, in summer, if the air were at say 80° and the earth at 50° , the latter, instead of giving, would abstract heat from the air, and the apartment would be cooler than if built on the surface. But in order that the fruit-room may be cool in winter, it should be insulated as much as possible from the constant source of heat existing in the earth.

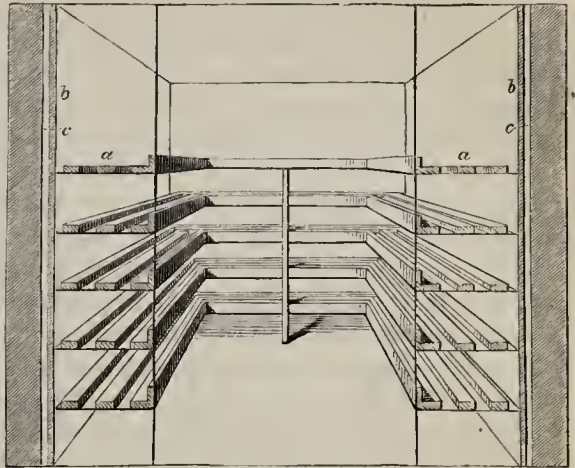
Vicissitudes of temperature have very injurious effects on the keeping of fruit. When fruit is warmer than the surrounding air, it is liable to shrivel; when much colder, a deposition of dew takes place on its surface, just as a cold mirror becomes dimmed with dew when brought into a warm room. In the commencement of cold or frosty weather, the fruit will be found dry, because warmer than the air, but when the thaw comes with comparatively warm south-west winds, the fruit will be found colder than the air, and covered with moisture. The alternate wetting and drying of the fruit, arising from vicissitudes of temperature, must be guarded against as much as possible, by endeavouring to maintain the greatest possible uniformity of temperature. The walls should therefore be hollow; and it has been shown that such can be built at less expense than solid ones. Fruit-rooms already constructed with solid walls ought to be lined with wood, leaving $\frac{1}{2}$ inch cavity between the lining and wall; indeed, a lining of this description is to be recommended, whether the walls are hollow or not. The roof should have a double ceiling.

That fruit keeps best in darkness, has been well proven. It has frequently been observed that the finest specimens of apples and pears, when placed opposite a window, soon acquire a much inferior appearance to that presented by those left in the dark.

Josiah Moorman, Esq., of the Clapham Road, has a fruit-room which combines all the above-mentioned favourable conditions. Fig. 259 is an interior view, and Fig. 260 a section of it. The construction of the room will be under-

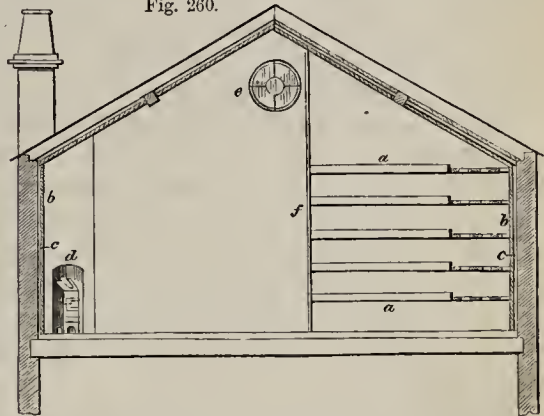
stood from the following explanation:—*a a*, shelves; *b b*, close boarding round the sides of the room; *c c*, air space between the boards and

Fig. 259.



the wall. There is also an air space on the north side, between the two plaster ceilings, as shown in Fig. 260; in which *d* is a stove; *e*, a circular window hung on pivots, and fitted

Fig. 260.



with a roller-blind; *f f*, partitions of open work similar to the shelves. The room is a partitioned-off portion of a loft, and has a coach-house below it; thus it is insulated from the earth, and consequently its temperature is not raised by heat from the latter. It has therefore a cool temperature, nearly corresponding with the mean of the winter season. The small stove is seldom used, unless the temperature of the room falls below freezing. The floor is wood, with a ceiling below; the roof is slated and double ceiled on the north side; the walls are of brick, between which and the wood there is an air cavity, *c*, about $\frac{1}{2}$ inch wide. Inclosed thus by non-conducting substances, the temperature of the internal air is not readily affected by changes that take place in that of the external air; for when the weather

becomes frosty, it is several days before the thermometer inside is lowered so much as one degree. A little fire is occasionally put in the stove, but only in severe frost or in a dry day, in order to speedily remove any damp that may arise from the fruit, air being freely admitted by the side window at the same time. Whether open or shut, the window is always covered with the roller-blind.

From the room above described, Mr. Moorman exhibited fine specimens of the Marie Louise pear, in excellent condition, as late as Christmas, and medals were awarded to him by the Horticultural Society, in different seasons, for his exhibitions of well-kept fruit.

The exhalations from ripe fruit have an injurious effect on that which is naturally late in becoming fit for use; therefore it would be well if the early ripening sorts were separated from the late by a close partition. We have seen choice pears and apples well kept in close drawers, care being taken to inspect them occasionally in order to remove any that exhibited the least symptoms of decay. There should be means at command for admitting a current of air, but this should be rarely put in practice; for, except when the air of the room is felt to be impure, the less air the better. When it is necessary to give air, the time should be watched when the external and internal temperature are alike, or nearly so, and if that be attended to, no deposition of moisture on the fruit will take place in consequence. When the external air is either much warmer or much colder than the air of the room, it should be excluded.

In order to absorb superfluous moisture in fruit-rooms, M. Du Breuil proposes to place a layer of chloride of lime in a wooden trough, lined with lead. This substance will absorb double its own weight of moisture from the atmosphere, and, as it liquefies, it may be received by a small spout into a jar. A fresh supply of the chloride of lime can be given as required. About 44 lbs., according to M. Du Breuil, will keep the air of the fruit-room sufficiently dry for a whole season; and the water can be evaporated so as to leave the chloride of lime again fit for use. This substance might be tried on a small scale at first, in case the flavour of the fruit might be affected by its presence.

Ice-house.—Although the melting of ice takes place when it is in contact with any substance above 32°, some melt it more quickly

than others of the same temperature; for instance, if in contact with moist earth or water, it will melt about twenty times quicker than if it were surrounded with dry air. The temperature of the earth in Britain averages, at some considerable depth below the surface, about 47°; the principal object should therefore be to insulate the ice as much as possible from this constant source of heat by the interposition of non-conducting substances.

An ice-house should be well-drained, for if the base of the mass is immersed in water, the latter will form a medium for rapidly transmitting upwards the heat of the earth to the ice. Care should therefore be taken to render the bottom of the ice-house as dry as possible, and the ice should rest on a wooden grating or on faggots.

The situation should have a northern aspect, and be dry and airy, not closely covered with trees, yet sufficiently screened from the direct rays of the sun. It should be sufficiently elevated to admit of good drainage. If no place naturally possessing this advantage can be had, the house must be elevated and an artificial mound formed.

The usual form is that of an egg, placed with the widest end upwards, and for various reasons this is doubtless the best. It is by the surface that a solid mass of ice is melted, and, accordingly, the form that presents the least surface in proportion to a given mass is the best, and that would be a sphere. In this form a mass of ice might have a surface of about 314 square feet, but if moulded into a form 6 feet broad, 5 feet thick, and 17½ feet long, it would have a surface of 445 square feet, more than one-third greater than in the spherical form; and if exposed to the same temperature, the sphere would melt in fifteen months, the oblong in ten months. But it must be borne in mind, that by taking away portions for use from the top, and by wasting at the bottom, the spherical form could not be long retained, whereas an oblong-spheroid or egg-shape, when reduced by the above causes, will approach nearly to the spherical or best form, by the time it is most tried by the summer heat.

The walls should be double, so that there may be an air cavity between the inner wall and the comparatively warm soil. If this cavity were ventilated during frosty weather, so much the better. The roof should be covered with a thick coat of thatch—heath

answers very well; and not only the roof, but the sides likewise ought to be dry, for rain water, of the temperature of perhaps 60°, must have a very great effect in heating the walls or other parts with which it comes in contact. Straw is usually placed between the walls and ice. It is a good non-conductor when dry, but is objectionable when it is wet and beginning to rot. If straw be used, the stoniest and least bruised that can be had should be employed; but reeds are preferable.

It may appear paradoxical, but the substances which are considered the warmest are the best for keeping ice from melting. If we fill a bottle with hot water, and wrap it in flannel, it will keep hot nearly twice as long as if the bottle had been freely exposed to the air, for wool, being a slow conductor, prevents the air from readily acquiring heat from the water. Suppose the bottle to be filled with ice, the same kind of woollen covering will prevent the ice from readily obtaining heat from the air, and, consequently, the former will be nearly twice as long in thawing.

In filling the house, the ice is generally broken, or somewhat pounded, in order that it may pack closer, but we have seen large masses put in without breaking; all cavities should, however, be filled with the fragments pounded, and the whole rendered compact by throwing water over the layers. In default of ice, the house may be filled with snow, well beaten, and watered if not in a wet state; it answers very well, and may be kept a twelve-month. Some use salt, but its utility is very doubtful, and, according to some, it is worse than useless. At all events, ice well insulated from earth and water, and shut out from the free access of hot air in summer, will keep very well without salt.

CHAPTER XXI.

FORCING.

I.—VEGETABLES.

ASPARAGUS.—The forcing of this is very simple as compared with that of many other plants where the growth of a tender foliage has to be carefully promoted by exposure to light in an atmosphere of a proper temperature and degree of moisture. But with regard to asparagus we have merely to apply a certain

degree of heat to the soil in which the roots are situated; the surface being kept warm by means of some artificial protection or covering, in order to prevent the shoot being checked in its growth when it appears above ground.

The heat required for the vegetation of the plants may be applied without removing them, or they may be taken up from where they have previously grown, and be transferred to a place where heat can be conveniently applied. In other words, the heat may be brought to the plants, or the plants to the heat. In the one case the roots are preserved entire; in the other, notwithstanding the greatest care in taking up, they must, to a certain extent, be mutilated. Such being the case, it is not difficult to say which is the most rational of these—the two modes of forcing usually adopted. The non-removal system is the one by which the largest and finest blanched heads are produced. It is that pursued by the French for obtaining their *asperges blanches*; and by removal and planting on beds they produce the *asperges vertes*.

The winters at Copenhagen are much more severe than with us. The average cold in January is much greater than that of the coldest January we have experienced in this country for fifty years, with the exception of that of 1838, and forcing under such circumstances must be much more difficult than in this country; yet, in the royal gardens at Copenhagen, Mr. Lindegard produced excellent asparagus in January, by means of horse-dung, in beds in the open air, and unprotected by frames and sashes. His mode of proceeding is detailed in the *Transactions of the Horticultural Society*, vol. v. p. 509, and, as it is simple, and had been successfully practised by him for thirty years, we may briefly state its essential points. His beds were 40 feet long, and 4 feet wide, with 2 feet alleys between. There were two rows of asparagus on each bed, and the plants were 2 feet apart. Four of the best beds were annually selected for forcing; and it should be particularly observed, that these beds were left uncut in the preceding summer. The crop had always to be delivered at a fixed period, the 28th of January, which was the king's birth-day, and forcing was begun four or five weeks previous to that date. Before forcing was commenced the beds were covered with a layer of litter or leaves to keep out the frost. Their surface was stirred with a fork, and the upper

spit of the alley thrown on to heighten them. The alleys were then cleaned out to the depth of about $3\frac{1}{2}$ feet, and immediately filled with hot dung, which was raised as high as $1\frac{1}{2}$ foot above the level of the top of the beds, and after having been trodden a little was covered with some old boards or planks. The surface of the beds was covered with some of the same kind of dung, or with litter to the depth of 3 or 4 inches, more or less, according to the state of the weather. The produce of each bed of the above dimensions, 40 feet by 4, was about 1000 heads, exclusive of small ones.

In a less severe climate a similar produce may be easily obtained by the above plan somewhat modified. The alleys need not be so deeply excavated; 3 feet instead of $3\frac{1}{2}$ feet will be sufficient, and it will not be necessary to raise the dung so high.

Near Paris, the asparagus beds are about 4 feet 4 inches wide, with 2-foot alleys between. The beds are planted with four rows of plants, about 9 inches apart in the row. They are forced in the fourth year after planting. In commencing, frames the width of the beds are put on, and a layer of vegetable mould and several inches of soil from the alleys are then spread over the surface covered by the frames. The trenches, which are 20 inches deep, are filled with hot dung to the top of the frames, and these are also filled with hot dung, which is removed as soon as the asparagus begins to reach the surface. The sashes are put on, and no air is given; on the contrary, they are covered at night with straw mats, and also during the day in cold weather, a temperature of from 60° to 75° being considered desirable. We should, however, prefer starting with a temperature of between 50° and 60° , as is done by means of hot-water pipes in the royal gardens at Frogmore. The heat may be increased so as to range between 60° and 65° , or not exceeding 70° ; for it is found that when asparagus is forced too rapidly, it is not so good as when it is brought forward gradually, with a temperature resembling that of a very fine May. Where glass is used, a good deal of sun-heat may be economized by keeping the sashes quite close till the shoots begin to appear. In the open air the finest and most tender shoots are produced when the beds have been exposed to powerful sun-heat.

With regard to the width of the beds intended to be forced there are two things to be considered. If they are too wide, the heat

of the dung in the trenches between them cannot readily get to the centre; and on the other hand, if the beds are too narrow, there is not space for the roots of the plants. They may be laid out $4\frac{1}{2}$ feet wide, with 2-foot alleys between; and in order to have fine shoots, the plants should not be less than 1 foot apart.

When the trenches are partially filled up after forcing is over, and the dung turned out, the roots strike into the decaying substances usually employed, so that when the beds are again about to be forced, these roots are destroyed in clearing out the trenches for the reception of the dung, and they are generally the most vigorous. This proceeding, in fact, deprives the plant of its most efficient feeders at the time they are most wanted. It is better to keep the trenches open, so as not to encourage them at all in that direction. In this case it would be well to cover over the trenches, in order to prevent the soil of the beds from being dried. In some instances, the sides of beds intended to be forced by dung-heat have been faced with bricks in the pigeon-hole fashion, and where the expense can be afforded, the plan answers very well.

In some places it is difficult to procure dung for the purpose of forcing, and in any case it is doubtful whether heating by hot water is not cheaper in the end. The labour required for working dung linings is very considerable, and would go far towards defraying the expense of fuel. At all events, the hot-water mode answers well where it has been adopted, as, for example, in the royal gardens at Frogmore. The beds there are 75 feet long and 7 feet wide; their sides are formed with pigeon-hole brickwork, and the spaces between the beds are 4 feet deep; but the lower half is filled with rich soil, and in the upper half there are a flow and a return pipe for hot water connected with a boiler which heats six ranges of flow and return pipes. The cavities for the pipes are covered with Yorkshire stone, and the beds themselves with a close-fitting wooden roof. Some think 7 feet too great a width for the beds; we should recommend 6 feet; and where such substantial covering as Yorkshire stone cannot be afforded, wooden covers will answer the purpose. At the royal gardens forcing is usually commenced early in December, and a supply is generally obtained by the end of the same month. A little air and light when the shoots begin to reach the

surface much improves the flavour and appearance of the asparagus.

Forcing removed Plants.—For these a hot-bed should be prepared, the heat of which should not exceed 70°. A heat of 65° will give a better produce, and higher than this is not to be recommended, unless a supply is urgently required for some particular occasion. The bed should be covered with about 3 inches of light soil or leaf-mould. The plants ought to be taken up with the greatest possible care, and the crowns immediately placed or packed closely on the surface of the bed, the roots being spread out regularly at full length; some fine light soil or leaf-mould must then be sifted over and introduced among the roots. The crowns should be covered to the depth of 5 or 6 inches. The sashes must be put on and kept close till the shoots begin to appear, when a little air should be admitted according to the state of the weather, to give colour to the tops.

Near Paris enormous quantities of asparagus are forced, in order to produce the *asperges vertes*, or green asparagus. We have seen an establishment in the Faubourg St. Antoine, the proprietor of which expended about £800 annually for plants; and M. Courtois-Gérard mentions, in his *Culture Maraîchère*, two market gardeners who together purchased in one year the plants which were produced on twenty-five hectares of land, or about sixty-one English acres. Plants three years old are preferred, for those four years old are generally once cut, and then they do not answer so well for forcing. The beds are prepared, and covered with about 2 inches of vegetable mould, on which the roots are closely packed and covered with light decayed dung or vegetable mould; but it is to be observed that the buds of the crown are not covered, the object being not to blanch the shoots, but to produce them green and very tender, so as to resemble green pease. In about two weeks cutting is commenced, and it is continued about a month, when fresh plants must be introduced for succession.

Green, or even blanched asparagus may be produced in any forcing-house, in a temporary pit formed of wood, or in boxes. The latter may be made so as to rest one above the other, in order to occupy comparatively little base room. They may be 2 feet wide, 3 feet long, and 1 foot deep, with an upright 20 inches long secured inside the box in each corner.

The uprights standing 8 inches above the upper edges of the box will serve as posts for supporting another similar box, and leave space for the growth of the shoots and for cutting. In this way four or five tiers may be placed along the back wall of a vinery or other forcing-house at work.

BASIL, if required in winter, may be sown thinly every month or three weeks from November to March, in pots or boxes of light rich soil placed in a temperature of from 60° to 70°. The plants may be thinned by taking the largest for use, or by pricking them out when about 2 inches high.

CAPSICUM.—*Capsicum*, L. (Pentandria Monogynia, L.; Solanææ, D.C.; Solanacææ, Lind.)—This is cultivated for the pods, which in a green state are used in salads, in pickles, and for making Chili vinegar; dried and ground, when ripe, they form Cayenne pepper. The frequent adulteration of this condiment with red-lead and other poisonous substances, renders the cultivation of the capsicum in gardens, with the view of obtaining a home-grown supply, very desirable.

For the above purposes several species and varieties of capsicum, mostly natives of the East and West Indies, are cultivated. The principal of these are:—The ANNUAL CAPSICUM, Spanish or Guinea Pepper (*C. annuum*), of which there are varieties producing red and yellow fruits; BIRD PEPPER (*C. baccatum*), *Piment enragé* of the French, a perennial; the SHRUBBY CAPSICUM (*C. frutescens*), a perennial, from which the Cayenne pepper is usually prepared; BELL PEPPER (*C. grossum*), a biennial; TOMATO CAPSICUM, *Piment tomate* of the French, producing fruit like a tomato in size and form, of a yellow colour, and comparatively mild flavour; RED TOMATO CAPSICUM, American Bonnet, Bonny, or Bonnet Pepper, like the preceding, but red, very productive and much milder than the small sorts; and the LARGE SWEET SPANISH CAPSICUM (*Piment gros doux d'Espagne*), large, much milder than the other kinds, and excellent for salads. The varieties which produce small erect pods are usually called chilies.

The seed should be sown in February or early in March, in pots or pans filled with light rich mould, and plunged in a hot-bed. When the young plants are about 2 inches high they may be pricked out singly into 3-inch pots, from which they must be shifted on, until in 6 or 8-inch pots, and in these they

may be allowed to fruit. The plants should be kept near the glass in a warm vinery, pit, or stove, and water ought to be frequently given. In warm situations in the south of England, fruit may be ripened in the open air. With this view, plants should be hardened off towards the end of May, and planted out in June, on a south border, at 1 foot or 18 inches apart, watering at planting, and subsequently in dry weather. In general, however, it is advisable to depend on plants under glass for a supply of ripe fruit; but where the green pods are in request, a considerable portion of the plants may, in warm situations, be turned out of doors. The fruit ripens in September, and may be kept two or three years in a dry room. The seed keeps best in the pods, and remains good for four or five years.

CARROT.—The best sort for forcing is the Early Horn; and in order to have a supply of this in a young state in winter, it may be sown in the end of November or beginning of December; again in the middle of January; and lastly in the beginning of February, if the weather be severe, or the situation cold and backward; but if such is not the case, this sowing may be made on a warm border. A hot-bed composed of 3 or 4 feet thick of leaves, or of 15 or 18 inches of dung, should be prepared, and covered with 8 or 9 inches of sandy soil and leaf-mould, so that the surface may be within about 6 inches of the glass. The seed may then be sown either broadcast, or in shallow drills, 3 inches apart, and covered with fine mould to the depth of $\frac{1}{2}$ inch. When the young plants come up they should be thinned to $1\frac{1}{2}$ inch in the row, or to 2 inches apart if sown broadcast. A temperature of from 60° to 65° ought to be maintained, and the sashes must be covered at night and in frosty weather; but as much light should be given as possible. Air ought to be given at every favourable opportunity, but cold draughts should be avoided; and, if the soil get too dry, a gentle watering may be given. Radishes are frequently sown along with the carrots; and this is also the custom of the Parisian market-gardeners.

CHICORY.—The blanching of this for salads having been treated of in a previous chapter, it will only be necessary to give the treatment for obtaining the young leaves in winter. These form an excellent and wholesome small salad, much used in France, but neglected in this country.

Seed is sown in light rich mould, either on a hot-bed, or in pans or boxes placed in a heat of from 55° to 60°; air is given at every favourable opportunity, and a gentle watering early in the day as often as may be required. The chicory may be cut in ten days or a fortnight after sowing; and the same plants will afford a second cutting.

CUCUMBER.—*Cucumis sativus* (Monœcia Monadelphica, L.; Cucurbitaceæ, D.C.; Cucurbitaceæ, Lind.)—The cucumber is a native of various warm countries of Asia, and probably of Africa. It was cultivated and in general use in Egypt in the earliest ages; there, favoured by the climate, artificial means of forcing it could not be required. At Rome, however, this was to a certain extent necessary, in order to meet the demand for a luxury which a production in its proper season could no longer satisfy; and therefore recourse was had to artificial means to obtain cucumbers throughout the year. The mode of effecting this for the table of the Emperor Tiberius was not widely different from that employed in the present day. Heat was obtained by frames filled with hot dung, and light was admitted through thin plates of talc, which would doubtless answer the purpose exceedingly well, especially under the strong light of an Italian sky. Pliny mentions beds mounted on wheels, so that in cold weather they could be removed under the shelter of buildings at night. The plants were also reared in baskets or in large vases, in order that they might be placed in the open air when the temperature was favourable, and taken in when it was otherwise. We should not think of moving a bed, with frame, sashes and all, into a house; but there is nothing preposterous in the idea of moving some kind of protecting structure over the bed; on the contrary, there would be good reason for doing so in certain cases; for instance, a shed lightly constructed of thin boards placed over a bed at night would protect it to a great extent from severe frost, and effectually from cold rain and sleet, which have the bad effect of cooling the linings, till by labour, with perhaps the introduction of fresh materials, the evil is remedied.

The cucumber requires for its successful cultivation a very rich light soil, a bottom-heat of from 75° to 80°, and a top heat averaging 75°, the range being between 70° and 80°. Moisture ought not to be at any time deficient; and it is of the utmost importance that the

foliage be exposed to as much light as possible; a thin shading, however, from the direct rays of the sun, when these are too powerful, is advantageous; and it may be added, that air should be given when it can be admitted without danger of lowering the temperature below, or at least much below, the limit above-mentioned.

As a general statement of the conditions most favourable to the growth of the cucumber, the above, we presume, will be found correct. We are aware that good cucumbers have been produced, although these conditions have not been fulfilled; but this is no reason why still better might not have been obtained had they been adopted. They cannot, indeed, be always commanded, and frequently have to be modified in practice, according to circumstances, but amidst the diversity of opinions, they constitute desiderata which we cannot err in endeavouring to attain.

Propagation.—The cucumber may be propagated either by seeds, cuttings, or layers. The first is the usual mode. Cuttings, however, are frequently employed for obtaining plants for winter forcing; they should be taken from the tops of the leading branches of vigorous plants in a bearing state, and planted in 9-inch pots, half filled with rich light compost, or leaf-mould. Plunge the pots in brisk heat, and place a pane of glass over their mouth. Layering is easily effected; a shoot may be introduced through the hole in the bottom of a pot, having its side partially sunk in the bed, and its mouth towards the south for light. Soil being put in, the shoot will soon take root, and still more readily will it do so if the pot be kept surrounded with dung that is warmer than the soil in which the roots of the mother plant are situated.

Soil.—The soil in which the seeds are to be sown should be rich and light; it may consist of well decomposed leaf-mould. Mr. Mills recommends finely-sifted peat, a lump of the same soil being placed at the bottom of the pot for drainage. Mr. Ayres employs two parts turfy loam, one part peat, and one part leaf-mould, with some white sand; and this we consider a very good mixture. Mr. Green, another excellent cultivator, uses turf of old maiden loam taken off not more than 3 inches thick, laid up, at least six months before using, in narrow ridges, with alternate layers of fresh horse-dung, and a good portion of straw. When required, this compost is chopped up,

but not sifted. The compost proposed by Mr. Moore consists of two parts good turfy loam, two of turfy heath-mould, three of leaf-mould, and one of clear coarse sand. The loam, besides being turfy, should be of a rather friable nature, so as to afford a ready passage for the roots, and for superabundant moisture. Turfy loam may in many places not be at command, and loam that is not turfy may have to be substituted. In this case a less proportion of loam, and more peat, leaf-mould, or decayed dung should be used, in order that a sufficient degree of porosity may be maintained. For winter forcing peat alone has been very successfully employed in dung-beds. Good peat has the property of preserving the roots during winter, when in other soils they are apt to damp off. Mr. Mills, well known for fifty years as a first-rate grower of cucumbers, says, "In the year 1811, I used the turf or peat obtained from Wansted Flats, in Essex, which contained a great quantity of white sand. This turf was chopped with a spade, moderately small, but not sifted; and in this the plants were grown without the admixture of any other soil. The plants thus treated proved as fine as I have ever had them since; and I cut fruit from them, in perfection, in the first week in February. The frames were raised in June to inure the plants to the open air; and at the end of that month the lights and frames were taken away to cover melons which had been propagated under hand-glasses. After this, the cucumber plants were trained over the top of the linings, and continued to produce abundantly till October, which is ample proof that the soil was what they liked.

"Peat-soil may be objected to as not being sufficiently rich; but when placed on sweet fermenting dung the roots will help themselves to food when the plants require it, and are swelling off fruit. I have tried numerous experiments with soils, variously mixed, from the year 1811 to the present time, and I am perfectly satisfied that *peat alone is best.*"—*Mills on the Cucumber and Melon.*

Where composts of the above description cannot be obtained, any tolerably rich, rather light soil, mixed with an equal quantity of well-decomposed dung will answer very well; or layers of soil 6 inches thick, and layers of the same thickness of fresh horse and cow dung mixed together, may be laid alternately one above the other several months previous

to use; and when the whole has been frequently turned, and has undergone a slight fermentation, it will be suitable for the purpose. We have seen a cucumber plant growing vigorously, though having its roots in only common garden soil; but this was in Ewing's glass wall, in which structure the foliage was much exposed to light on all sides, and solely owing to this the plant was more robust than others grown under circumstances less favourable as regards the amount of light. In summer, during a period when both days and nights are warm, it may be observed how healthy are cucumber plants growing in the open air, and freely exposed to light without the intervention of glass, and of how dark a green is their foliage. Such favourable periods are, however, in our climate only the exceptions, and means must therefore be employed to produce artificial heat, as well as shelter from cold winds, rain, and snow. We ought to be prepared to maintain a tropical heat amidst all the inclemencies of a northern winter. The modes of doing this were formerly confined to dung-beds and linings, by which heat could be generated with little expense for constructions in the first instance; but various others are now employed, and render the maintenance of a proper degree of heat, even in the middle of winter, less precarious. Therefore, in first-rate gardens, these modes should be adopted. Yet a supply of cucumbers for a considerable period can be obtained from a frame with two lights. We have seen many cut from even a one-light frame, but a two-light one is not much more expensive; and while double the produce or more can be obtained from the former, the quantity of heating materials required is less than double, and the labour and attendance is much the same in both cases. In other words, a one-light frame is more expensive in proportion than a two-light, and this again than a three-light one.

Those who require cucumbers in the middle of winter ought to be aware that they cannot be produced at that period without considerable expense; if this can be afforded, the best plan is to erect structures heated with hot-water apparatus for the purpose; but where the necessary outlay for houses or pits cannot be made, it is better not to attempt very early forcing by means of dung-beds, indeed no earlier than is consistent with the chance of being successful with a moderate amount of labour applied on good principles. Keeping

this in view the seeds may be sown in the first week in February.

The preparation of materials for the seed-bed ought to commence about the middle of January. A quantity of good stable dung should be thrown into a conical heap, mixing at the same time the long and short, dry and moist, thoroughly together. There should, if possible, be as much short moist dung as will prevent the littery portion from becoming dry in the course of fermentation. If the litter is dry, and in too large a proportion, it may be separated from the short dung, and soaked in the drainings from the stables, or it may be thrown in a heap, each layer being well watered with stable drainings, if such can be obtained, or otherwise with water alone, and each layer when watered should be beaten with the fork. When this, the previously dry littery portion, is rendered thoroughly moist, it ought to be formed into a heap, mixing it at the same time with the short dung from which it was separated. When the heap is in a full state of fermentation it should be turned, carefully mixing long and short as before, and that which was at the top must now be at the bottom. If, in the course of the operation, any patches of litter not sufficiently moist should be met with, they ought to be laid aside in order that they may be well watered, and beaten at the same time with the back of the fork before being incorporated with the general mass. If the whole is found to be not moist enough, water should be applied from the rose of a watering-pot as the work proceeds. In a few days the materials will be again in a full state of fermentation; when this is the case, the heap should be turned, and when fermentation has for a third time become general, the formation of the bed may be commenced. The third fermentation may be effected in the space of a fortnight.

The situation of the bed should be sheltered from north, north-west, and easterly winds, but open to the south. The less obstruction to the full light from this quarter the better. The dimensions of the frame being known, an area 6 inches larger should be marked out, so that when the bed is built up and the frame placed, it will be, at both sides and ends, 6 inches from the outside of the bed. Some put a layer of brushwood on the ground; others long dung. Proceed next to form the bed, layer after layer, the materials of each being well shaken and mixed, and then beaten

with the back of the fork, so as to be uniformly compact. The upper layer should consist of some of the shortest materials. The bed should be 6 inches lower at the front than at the back; and at the latter the height may be from $3\frac{1}{2}$ to 4 feet. When the bed is completed the frames should be put on, and the lights kept close till the heat exceed 80° , when the sashes ought to be raised to permit the escape of steam. When the bed has settled a few days, some light soil, peat, or half-spent tan, should be spread regularly over the surface to the depth of 5 or 6 inches. In a few days more this covering will acquire the temperature of the materials on which it is laid. It would be well to try the heat of the bed by a thermometer. The indications of this should be frequently noted, at regular intervals, in order to ascertain the rate at which the heat increases. If at the first trial, it is, for instance, about 70° , and if it progress but slowly towards 75° or 80° , the seed pots may be safely plunged. If higher than 80° , and from the rate of increase likely to be much higher, precautions must be taken lest the young plants should be injured by too much bottom heat.

Times of Sowing.—Mr. Mills sows for early fruit on Michaelmas day; Mr. Green on the 1st and 20th of September, and 5th of November; the plants of the first sowings he fruits in pots, those of the third he plants out in a pit. From the plants sown on the 1st of September he cut the first fruit on the 4th of November; and from those of the second sowing on the 10th of January.

The seeds should be proved before sowing by putting them in water for an hour or two, when those only which sink to the bottom ought to be taken for sowing. The soil may consist of sifted leaf-mould or sifted peat, with a piece of fibrous turf or peat at the bottom of the pot for drainage. It will be found most convenient, in many cases, to sow singly in 3-inch pots. Let the seed be pressed into the soil, and covered not more than $\frac{1}{2}$ inch. Some recommend sowing four seeds in a small pot; Mr. Mills nine in a 9-inch pot, placing them round the edge. This mode, practised by a person of great experience, has doubtless been found to answer well; still, by having the plants singly in pots, some can be safely reserved in case of accident when the others are shifted.

If it has been ascertained that the bed is

of the proper temperature, between 75° and 80° , the seed-pots may be plunged about half way in the soil; but should the heat be above 80° , or likely to increase beyond that point, it will be advisable to sink a small pot, mouth upwards, and place on this the bottom of the seed-pot. The latter will thus be insulated from immediate contact with the hot materials of the bed, and its temperature must be influenced by that of the air of the frame; and this can be regulated to the required degree by giving air. When, however, the pots can be plunged in soil, tan, or other materials, possessing the requisite degree of bottom heat, it is better to do so; for the temperature thus imparted to the pot and its contents will be more steady than if the heat were derived from the air. When the plants begin to appear above the soil of the pots, care should be taken that they are within 6 inches of the glass—indeed, the nearer the plants are to it the better, as regards the beneficial influence of light; on the other hand, when too near it they are apt to be affected by the coldness of the glass, especially when this is rendered very cold by rain and sleet. At the above distance the cooling effects of the glass will be neutralized by the natural ascent of warm air from the surface of the bed. Therefore, if the seedlings are further from the glass than about 6 inches, let the pots be taken up and plunged at the required height in soil gathered up from the surface of the bed.

Presuming that there are several seedlings in the same pot, they will require to be potted off, when they have formed the first rough leaf, into pots 3 or $4\frac{1}{2}$ inches in diameter, in soil composed of decayed leaf-mould, well mixed with some turfy peat or light turfy loam, chopped fine, but not sifted. The plants should be held, so that when the soil is filled in to within 1 inch of the top of the pot it may be nearly close to the base of the seed-leaves. The shifted plants must then be replaced in the frame, their foliage being kept near the light as before.

Stopping.—This operation should be first performed when the plant has pushed so as to have two joints; the growing point must then be stopped by pinching it off above the second joint. The second stopping ought to take place when the shoots which push in consequence of the first have grown so far that the growing point can be pinched off above the *third* joint. Some growers occasionally

stop the second time above the fourth joint, whilst others stop in the first instance above the first joint, and the next time above the second.

The heat of the seed-bed should be frequently ascertained by means of a bark-bed thermometer, or it may be done by means of a cheap common thermometer. One of this description may be inserted nearly its length below the surface of the bed, and by fixing it to a rod it may be introduced from the outside to the centre of the bed. If the temperature is found to be high enough but on the decline, then linings, or coatings, as they are now sometimes and more properly termed, must be applied in time. By attending to the indications of the thermometer, and observing the rate at which the temperature is declining, the time it will reach the point below which it should not go, can be nearly enough ascertained. This being known several days previously, materials for preventing, to a great extent, the escape of heat, or for generating a fresh supply, can in the meantime be supplied. If the temperature is found to decline but slightly in a given period, it will probably be sufficient to apply a coating of litter, straw, or some other slow conducting substance, not in a state of fermentation. On the other hand, if, from the state of the weather or other causes, a too low temperature is anticipated, prompt measures must be adopted to prevent its taking place. A coating of materials already in a state of fermentation, such as hot stable dung, or some of the fermenting materials from the mass of those in course of preparation for the fruiting beds, should be used for the purpose. Cold winds have a great effect in extracting the heat from hot-beds. Dry litter or straw is very efficacious in preventing the escape of heat, and therefore proper for surrounding the bed. Straw mats may be very advantageously employed above the linings.

Materials for the fruiting-bed must be prepared as directed for the seed-bed. Where there are plenty of leaves at command it is a good plan to mix a quantity of them with the dung, as they tend to render the fermentation less violent at first, but more lasting. The heat from the fermentation of stable dung will exceed 150° under circumstances favourable to its development, and that temperature is far too great for vegetation. If fresh horse dung is mixed with cow dung the

heat becomes still greater; it is therefore evident that such a high state of fermentation ought to be checked by turning the mass, and otherwise moderating it by the admixture of materials disposed to make a slow, mild fermentation, such as leaves or old half-wasted hotbed dung. The shortest materials should be used for the upper layer of the bed, or for this some employ half-decayed leaves. If made up in the first week in February, the height may be 4 feet in front and $4\frac{1}{2}$ feet at back. The bed is formed layer by layer like the seed-bed. We may mention, however, that some of the best French cultivators, instead of raising the bed by horizontal layers, begin at one end, raising the materials to the proper height, and work backwards to the other end. In whatever mode the bed is formed, the frame and lights ought to be put on and kept close till the heat rise to the surface of the bed, which should then be forked over several times, at intervals of two or three days, to the depth of 9 inches or 1 foot, still, however, keeping the short materials at the top. If, in the course of this operation, any of the dung should be found too dry, or likely to become so, it must be watered through the rose of a watering-pot. The thermometer should be employed to ascertain the heat of the bed, whether too little or too much, whether declining or increasing so rapidly as to give rise to well-grounded suspicions that it must soon become too violent. In this case steps must be taken to moderate the fermentation: beginning at one end, the upper portion of the bed, as far back as the width of a sash, can be removed to the depth of at least 9 inches, watered, and the materials returned. Portion after portion should be so treated till the whole is moistened; care must, however, be taken not to give too much water, so as to chill the bed too much. Holes are occasionally bored in the sides of the bed with a stick, when it is necessary to lower the temperature either before or after the plants are introduced. The sticks should be put in about two-thirds above the foundation of the bed, and ought to point a little downwards towards the centre. If the heat is not above 85° or even 90° there is absolutely no danger of its injuring the roots of the plants if due precautions are taken.

Three or four days, at least, before the plants are introduced into the frame prepared for fruiting, some barrow loads of soil adapted

for the growth of the plants, should be put into the frame, in order to acquire a temperature of 75° or 80°. It should then be gathered up in hillocks, one under the centre of each light, or rather nearer the back than the front. They must be raised so that the plants may be within 6 inches of the glass. The tissue of the young plants is very delicate, and not adapted to bear vicissitudes of cold or dryness, more especially if these occur suddenly. Therefore, before planting out, it will be well to place the plants in the frame for a day or two, without turning them out of the pots. The soil in these will acquire the same temperature as that into which they are to be transplanted; and, consequently, when this takes place, no check as regards temperature need be apprehended. The soil of the hills or mounds, raised for the reception of the plants, should be moist, but not what would be termed wet, and the soil in the pots ought to be in a corresponding state of moisture with that of the hills. Then, by carefully turning the plant out of the pot, it may be planted in the top of the hill with its ball entire.

Watering.—Cucumber plants should always have plenty of moisture regularly supplied; for a superabundance at one time cannot compensate for a deficiency at another. The demand for moisture at the root increases as the foliage expands. It depends also on the temperature, the greater or less dryness of the air, and on the amount of ventilation. Care should be taken that the temperature of the water be about the same as that of the soil in which the plants are growing. The asparagus is a hardy plant, and its shoots push rapidly in spring whilst the ground is heated by the sun's rays; but, though a marsh plant, if the ground is moistened by cold rains, the growth of the shoots is for some days greatly checked. We need scarcely say that if the asparagus is thus affected, the cucumber must be much more so. A plant of an herbaceous nature growing in brisk heat will actually droop from the application of water of a much lower temperature than that in which the plant is growing at the time. It is easy to bring the water to the proper temperature by admixture with a portion of boiling water, and when it is mixed it is not much trouble to dip a thermometer into the water, and so ascertain if it is of the proper heat. If the heat of the soil of the bed is rather low, that of the water may be a degree or two lower, but not on any account higher.

The temperature of the water with which the plants are syringed should nearly correspond with that of the air in the frame, but rather lower than otherwise. If the materials of the bed are likely to get too dry after the plants are in the hills, the portion not occupied by the hills may be well moistened with water of from 70° to 80°, higher if the bed is too cold, and lower if too hot. Water may also be introduced by inserting the prongs of a fork in a slanting direction below the hills.

In watering the young plants whilst in pots, of course a fine rose ought to be employed; and likewise when they are planted out on the hills, in order that the soil may not be washed from the roots. In winter, or early spring, the soil should be watered about ten A.M., shutting down the lights for a short time, in order to prevent a chill taking place from rapid evaporation, then gradually admitting air, more or less, according to circumstances. In dull moist weather it is advisable not to wet the foliage, and the stem as well as the soil immediately surrounding it should be kept dry. In summer, watering is usually commenced about four P.M.

Giving Air.—The chief object of this is to prevent the temperature within the frame from getting too high. Air, however, requires to be admitted with great caution in the early part of the season, when the disparity of the temperature within the frame and that of the external air is very considerable, and when the plants are young and tender from growing in a warm moist atmosphere, they are readily affected by the contrary. The warm moist air of the frame is soon displaced by the admission of cold air; and the colder the air the sooner does this take place. As the cold air becomes heated, its capacity for moisture is increased, and accordingly it then takes up moisture wherever it comes in contact with it, and the surface of the leaves is too suddenly dried. As little air should be given as is possible in winter and the early part of spring. It must never be given with the view of lowering the temperature, but rather with that of preventing it from becoming too high; for example, if 90° may be permitted by sun heat, air should be given in such time and manner as will prevent the temperature from rising above that point, instead of allowing it to rise, say to 100°, and then lowering it to 90°, by giving a large amount of air. Doubtless the true principle of giving air is to admit it as progres-

sively as the temperature increases. This, of course, could not be carried out in practice; nevertheless, it should be borne in mind and acted on as far as circumstances will permit.

The bad effects of a draught of cold air admitted directly into the frame might in a great measure be prevented by employing what may be termed respirators. Woolaston's Northampton netting would answer the purpose, if placed so that the ingress of cold air and egress of warm must be through two folds 3 or 4 inches apart. A contrivance of this kind will probably be brought into use; but at all events a single fold of the above or similar materials could be readily employed, and would prove advantageous, particularly when a little air has to be given at night to permit the escape of gases, with which the air of the frame is apt to be overcharged.

Coverings.—Until the nights become warm these are necessary. It would be desirable to have them of a description that would keep the glass both warm and dry. Double mats are used in severe weather. When the nights are very cold, and especially if the heat of the bed is not very strong, a thin coating of hay next the glass is a great protection. As the cold decreases the covering may be reduced to a single mat, and in summer that may be dispensed with.

Shading is necessary when the sun's rays are powerful, but the air at the same time too cold to be admitted to an extent sufficient to counteract their effects. It is employed at other times when the plants are evidently suffering from a very hot sun, as is most apt to be the case on a sudden outbreak of sun after dull wet weather.

Pruning.—The cucumber naturally extends its shoots or vines to a much greater distance than the width of an ordinary frame; and if their growth were not regulated by pruning, they would become overcrowded and weakened in consequence. Stopping the plants at every stage of their growth, as already directed, will cause several shoots to break near the stem. Select three, or at most four of these, of as nearly equal strength as possible for principal branches. Encourage laterals from these to fill the frame sufficiently, and to bear fruit. Stop at one, two, or three joints above the fruit, according as there is room. All weak shoots ought to be removed at an early stage of their growth; and those which are left should be kept moderately thin and regular. This regu-

larity ought, however, to be more the result of foresight in preventing confusion than in effecting a clearance by cutting away large quantities of entangled shoots. The knife should be very little employed; superfluous shoots ought to be pinched off with the finger and thumb, for when so treated they do not bleed so much as when severed by a clean cut with the knife. By attending to these directions the plants will receive no material check in consequence of a sudden privation of foliage, and will therefore be less subject to disease, and will be able to bear abundance of fruit in succession.

The cucumber bears male and female flowers on the same plant; the former consist of petals and stamens only, while the latter have all the organs of fructification with the exception of the stamens. Formerly great pains were taken to fertilize the female flowers, but it has been proved that this is not necessary except where fruit is to be grown for seed.

In dry weather more especially the fruit is apt to become crooked. To prevent this various means have been resorted to. Glass tubes are now made for the purpose, and are very convenient; or three pieces of thin board may be nailed together like the bottom and sides of a box, 3 inches wide and 2 inches deep, and lined with three slips of glass. A number of these can be prepared, and they will be found to answer the purpose very well.

Instead of training the shoots along the surface of the beds some prefer training them on trellises. To allow space for the leaves these should be placed from 9 inches to 1 foot from the glass; and from 12 to 18 inches from the surface of the bed to admit of the fruit growing downwards in a perpendicular direction. The plants must be trained with a single stem to an upright rod till they reach above the trellis, when the leader should be stopped, in order to obtain ramifications for covering the trellis. The principal among these must be stopped when other branches are required; unfruitful laterals ought to be removed, and those which are bearing fruit should be stopped, so as to leave one joint beyond the fruit, till such time as it can be seen whether or not a shoot will push from the same joint as the fruit; if one does so, pinch off that which is above it.

Ridge Cucumbers.—In warm summers cucumbers may be produced abundantly on

ridges in the open air, protected in the first instance by hand-glasses. The plants should be raised in heat, in the end of March, in small pots. They are best reared singly, till they can be planted out under hand-glasses on ridges formed over hot dung. In making the ridges a trench should be thrown out 3 feet wide, 1 foot or 18 inches deep, laying the soil on the north side. The trench must then be filled with hot dung, and if this can be raised to the thickness of $2\frac{1}{2}$ feet, so much the better. The dung should be covered with about 9 inches of the soil dug out of the trench, or with other rich soil, the surface being made to slope towards the south, and backed up with the soil thrown out of the trench. The hand-glasses must be kept on as long as the growth of the plants will permit, and in cold nights mats or other covering should be thrown over them. The application of any means that may be contrived to afford shelter in cold nights, will of course prove advantageous, as is likewise a mulching of litter; but fresh stable litter, strong in ammoniacal exhalations is injurious to the foliage.

Near London, cucumbers are extensively cultivated in the open ground. The plants are raised under glass, and hardened off so as to be planted out in the end of May or early in June.

Gherkins—a small sort of cucumber grown for pickling—are now frequently sown in the open ground instead of being reared in a frame and transplanted. Some let the plants run without stopping. The French pinch off the extremity of the primitive stem above the third leaf.

EGG PLANT.—*Solanum Melongena*, L. (Pentandria Monogynia, L.; Solanæ, D.C.; Solanaceæ, Lind.)—This is a greenhouse annual, a native of South America, as well as of the tropical parts of Asia and Africa, and introduced into Britain in 1597. It is cultivated for the fruit, which, when properly dressed, is excellent; but the mode of preparing it is scarcely understood by any but French cooks. In Provence the fruit is cut longitudinally in two, and the seeds and spongy substance surrounding them are taken out. The two halves are then placed on the gridiron, with the cut faces upwards, and whilst roasting, the flesh is soaked with fine salad oil or fresh butter, applied a little at a time, a sufficiency of pepper and salt being added. Some augment

the flavour with parsley, anise, or other aromatic herbs; others place an anchovy or a pilchard between the two pieces. The great difficulty in cooking is to avoid the flavour of smoke; with this object in view the fruit is sometimes cooked between two plates.

Another mode of preparation consists in peeling the fruit, placing it in a frying-pan, scoring it across and across, filling the incisions with fine Florence oil, and then sprinkling with salt, pepper, nutmeg, and grated bread. When half cooked a little aromatic vinegar is poured over the fruit, and when the process is completed the latter is served up garnished with parsley or chervil.

There are several varieties with round, oval, and oblong fruit, of a white, red, yellow, or dull purple colour. The best is the **LARGE PURPLE**, the fruit of which sometimes measures as much as 6 or 7 inches in length, and 12 inches in circumference. Another variety, the **CHINESE BRINJAL** (*Aubergine blanche longue de la Chine* of the French) produces a long white fruit, the flesh of which is considered to be more juicy and less fibrous than that of the other sorts.

To ripen the fruit perfectly the seed should be sown in January, in pots or pans of light rich soil, placed in a temperature of from 65° to 70° . When the young plants have made two leaves, they may be potted off singly into small pots, from which they should be shifted on till in 8 or 10-inch pots, in which they may be fruited. The plants ought at all times to receive abundance of water; and manure-water may be occasionally given until the fruit has nearly attained its full size, after which the application should be discontinued. The plants ought to be grown with a single stem, which must be pinched to encourage the production of two branches, which should themselves be stopped to make them throw out laterals. When four fruits are set, no more fruit or laterals should be allowed to form.

The Parisian market gardeners adopt the following mode of cultivation. They sow about the end of December, or beginning of January. "A hot-bed is prepared, the heat of which should be from 68° to 77° ; it is surrounded with a good lining, and covered with a layer of vegetable mould, about 5 inches in thickness; and when the requisite degree of heat is attained the seeds are sown. The sashes are covered at night with a good straw

mat. A fortnight or three weeks after sowing, a second bed, not so hot as the first, is prepared. This is covered with vegetable mould, and when their cotyledons are well developed, the young plants are pricked out into this second bed, and, after some time, they are again taken up and replanted in the same bed, but at the distance of 8 or 9 inches from each other. The covering up of the sashes at night is still continued; and, as soon as the young plants begin to grow, a little air is given if the state of the temperature will permit.

"In the course of the month of March another hot-bed is prepared. The frames are placed, and the bed covered with vegetable mould. When the bed is of the proper heat, from 60° to 68°, four egg plants are planted under each 4½ feet sash. They do not get air for several days, in order that the plants may more readily take fresh root, after which a little air is given, by pushing the sashes either up or down; and these are opened wider as the season advances, so that they may be taken off in the month of May. The further attention they require consists in watering when necessary, and in cleaning the leaves, which are often attacked by the scale or by the red spider; next, all the young shoots which spring from the base of the stem are taken off, in order to obtain one main stem, which is pinched when it is sufficiently strong, with the view of forming two main branches, which are themselves pinched at a later period, in order to induce the development of laterals on them; and when the fruit is set, all the young shoots are taken off, in order to increase the size of the fruit. By these means fruit fit for gathering may be obtained about the end of June or beginning of July, and the plants bear in succession till October."—*Gardeners' Chronicle*, 1853, p. 725.

ENDIVE is very seldom forced in British gardens; but in France this excellent winter salad is regularly forced, not only in private gardens, but even for the public markets.

According to the *Bon Jardinier* the following modes are adopted to obtain endive in winter and spring:—It is sown in January and February on a brisk hot-bed covered with vegetable mould, which is afterwards beaten with the back of the spade to give the seed a hold. Some do not cover the seeds at all; many only scatter a very thin layer of fine mould over them at the time of sowing; whilst

others only do this after germination has taken place. In all cases, however, sowing in a brisk heat is considered to be the only method of obtaining plants which do not run to seed. A fortnight or three weeks after the plants come up they are pricked out into another hot-bed, where a less degree of heat is maintained. Air is given when the weather is favourable, and the plants when sufficiently hearted, are tied up as when grown in the open ground. The endive produced in this way is perfectly blanched and of good flavour, and is sold at Paris in March and throughout the spring.

There is another mode which has been successfully practised of late years, and in which the seed is sown from the 10th to the 15th of September, in the open ground, under bell-glasses, or in a cold frame. About three weeks afterwards the young plants are pricked out under other bell-glasses or into cold frames; and in November or December they are planted close together in frames. The plants must not be exposed to the air, otherwise they toughen; they should therefore be kept close; and in frosty weather they must be protected with litter and straw mats. The endive obtained in this way is very small, but well blanched and very good. The French Small Green Curled is the kind generally employed for forcing.

By a mode of treatment nearly the same as the preceding, the Parisian market gardeners obtain endive fit for use in January and February. They also sow in January or February the French Small Green Curled on hot-beds, giving a heat of from 77° to 86°; for, in order to produce plants that will not run, the seeds must germinate in twenty-four hours, no matter at what period of the season it may be. They press in the seeds, cover the sashes with several straw mats in order to keep in the heat, and sprinkle a little fine mould over the seeds when germination takes place. Afterwards, water is given through a fine rose, as required; and about a fortnight after sowing, or when the plants have made four leaves, they are pricked out on another hot-bed, and replanted a fortnight or three weeks afterwards on a moderate hot-bed. The sashes are covered at night with straw mats; air is given at every favourable opportunity; and the plants when of sufficient size are tied up to blanch. The plants from the first sowing are fit for use in the end of April.

KIDNEY-BEAN.—This is easily forced, for it will succeed under a high temperature—as high as 80°, and as low as from 55° to 65°. Hence it may be grown in pots in any forcing-house in which it can be duly exposed to light. Where the temperature can be specially regulated for this vegetable, a minimum temperature of 60°, and a maximum of 75°, or 80° by sun heat, will be found very proper. The bottom heat ought at least to correspond with the mean temperature of the house. It should be borne in mind that as regards the temperature of the soil, the kidney-bean is very different from pease and beans, for these grow and maintain a healthy foliage when the soil is so cold that the kidney-bean will either refuse to vegetate, or, if it do so, it only exhibits a yellow sickly foliage.

Early dwarf sorts, such as the Early Dwarf Dutch, Early Laon, Wilmot's Forcing Cream Speckled, Fulmer's Early Dwarf, Newington Wonder, and Black Belgian, should of course be selected for forcing. The Newington Wonder is very prolific, and answers well, but requires to have the tops pinched, as it is not naturally dwarf enough for some situations.

In forcing this vegetable, there is perhaps no better or more simple plan than sowing in pots; and in order that in these the naked stem may be earthed up, and yet allow sufficient depth of soil for the roots, the pots should be deep. They may be half-filled with light turfy soil and leaf-mould, or decomposed cow-dung. The stem should be allowed to grow without earthing up till the proper leaves are formed, in order that, by exposure to the air, it may acquire more firmness than if it were earthed up earlier. The plants must be well supplied with water, for if at any time they are allowed to get too dry, that which is most to be dreaded, the attacks of the red spider, will be encouraged. The plants should be well syringed, at least till they come into flower. It is impossible even by this means to thoroughly moisten the under side of the leaves; but this can be done by syringing early in the morning, and then keeping the house shut up till the air and vapour acquire a higher temperature than that of the plants; for example, the latter may be kept comparatively cool by syringing with water at 60°, whilst the air of the house is raised to 75°, or even 80°, for some time. Every portion of the surface of the leaves will then, in consequence of condensa-

tion taking place, become thoroughly wetted, which could not otherwise be the case even if the plants were completely immersed in water. Give plenty of air when the plants are in flower. By forcing, kidney-beans fit for use may be obtained in six weeks or two months from the time of sowing. Some, therefore, may be sown in August to succeed those in the open ground; and for succession, other sowings may be made every month till the following March.

LETTUCE.—Although in summer the lettuce succeeds well in the open air in our climate, and although in winter we can readily give it as much heat as it can at any time require, yet, being of very tender substance, it is apt to damp off in the latter season, when light is deficient and moisture too abundant. The more heat we apply under these circumstances the more lax will be the tissue, and consequently the greater will be the liability to decay. The plants must be kept in a growing state; but, in forcing, it is evident they cannot bear to be grown so rapidly in our dark and damp winters as they are naturally in summer, when they enjoy the advantages of free air and abundance of light. In France they at present far excel us in the cultivation of lettuces in winter, partly owing to the great attention they bestow on this branch of culture, and partly owing to the superior brightness of their sky, and the less humidity of the climate. Attention it is quite possible to give in an equal degree in both countries, but as regards light and humidity the odds are much against us. Taking all these circumstances into consideration, it is evident that we must act on the principle of giving heat to grow the plants but slowly in dull damp weather; we may increase heat when the days prove bright; we must expose the leaves to all the light we can by keeping the glass clean and the plants near, but not touching it; and, finally, we must endeavour to guard against humidity and its effects by every means in our power.

The sorts which may be employed for affording a winter supply, either by protection or by a gentle process of forcing, are, of cabbage-lettuces, the Hardy Hammersmith, White Dutch, and Brown Dutch; and of Cos lettuces, the Artichoke-leaved, the Brown Cos, and the Green Paris Cos; and towards spring tho White Paris Cos may be produced, as its superior quality renders it desirable; but the

others, being hardier, are more to be depended on for the main supply. These varieties should be sown about the middle of August, and in the beginning and middle of September. In many instances two sowings, namely, those in the middle of August and middle of September, would be sufficient; but we have recommended an intermediate one in the end of August or beginning of September, in case of accident to either of the others. These sowings ought to furnish plants for a supply during the winter and spring. The seeds should be sown in rich light soil, or in a compost of well-decomposed dung, leaf-mould, and the soil from an old cucumber bed. Although the soil must be rich, yet strong manure ought to be avoided. In either case, as soon as the first two leaves can be laid hold of, the plants should be pricked out 3 inches apart each way, in a bed prepared like the seed-bed. It is presumed that up to the end of November a supply of lettuces fit for table will be afforded by sowings made in the end of July, some of the plants being planted in temporary frames, in order that they may be protected from frost. Sown in the end of July, the Artichoke-leaved will give a supply of Cos lettuces in December, with scarcely any protection, if the weather is not severe; but it would be advisable to introduce some into a cool frame before there is danger of frost. The plants may be almost full-grown. They should be taken up with balls, and planted in nearly dry peat and sand; water, if at all necessary, must be used very sparingly; the foliage should not be wetted. By covering the sashes at night, the soil in the frame, and likewise the plants, will be maintained at a higher average temperature than that of the external air; and whilst this is the case condensation will not take place, and damping off will be prevented. We have seen Cos lettuces succeed very well in winter, within a cheaply constructed protection, consisting of a row of posts at back, and corresponding with these a row of shorter ones in front, with strips of wood along their tops, so that rafters could be extended with a slope sufficient for the water to run off. A few thin strips of wood, extending horizontally, and nailed to the posts, afford the means of securing clean-drawn straw, disposed perpendicularly, to the thickness of 2 or 3 inches, for closing in the back and ends. The whole can be done so as to have a neat appearance, and constitute, at the same time, a warm inclo-

sure. Its width may be 6 feet, or as much as spare sashes will cover. If sashes are not at command, straw mats may be employed for covering at night. By the aid of these, and other means of protection that circumstances and materials may permit, lettuces from late summer sowings will afford a supply till the beginning of January, by which time those from the August sowing, and forced in frames with a little artificial heat, can be obtained in a state fit for use.

About the middle of October make a slight hot-bed, of about 18 inches thick, of well-prepared dung. Cover this about 1 foot deep with a compost of sandy peat, leaf-mould, and a little well-decomposed manure. The bottom heat should be about 55°. When the soil is put in the frame it ought to be thoroughly watered, and then allowed to get nearly dry. As soon as this is the case, take up carefully with balls the plants which were pricked out as directed from the seed-bed, and plant the Cos and Brown Dutch varieties about 9 inches apart in the frames. Water slightly after planting, and then cover the whole surface of the bed with clean dry sand or dry peat: some recommend charecoal, but it is apt to soil the foliage; peat-charecoal may, however, be employed with advantage. Shade from sun, and keep the lights close for a few days, till the plants have taken fresh root. Afterwards, give plenty of air when the weather permits. Great care should be taken to prevent frost from reaching the plants. In case of severe weather the frame must be backed with litter, and, instead of Russia mats, good straw mats should be used for covering the sashes.

MINT.—Green spearmint is almost indispensable in most families early in spring, and is frequently required throughout the winter. It is easily obtained by planting roots from time to time in a moderate hot-bed, so as to keep up a succession till a supply is produced in the open ground; or, when only a small quantity is required, they may be taken up early in November, and planted in pots or boxes of light rich soil, and introduced in succession into a hot-house with a temperature of from 55° to 65°, or plunged in a hot-bed. In either case the roots may be planted close together, and should not be covered with more than 1 inch or 1½ inch of fine soil. Water must be frequently given. Forcing may be commenced early in November, and discontinued in March.

MUSHROOM (*Agaricus campestris*, L.—*Cryptogamia Fungi*, L.; *Fungi*, D.C.; *Fungales*, Lind.)—Indigenous to Britain, and, indeed, to every quarter of the globe; spawn of a large variety of it was sent by Mr. Drummond from the Swan River. Its propagation is effected by means of spores, which are therefore analogous to seeds; they are exceedingly minute bodies, imperceptible to the naked eye, and are produced on the part of the plant exposed to the light, above ground. In cultivation, however, mushrooms are reared from *spawn* or *mycelium*, as it is termed by botanists. This has the appearance of a white mould, in which state it will remain and retain its vegetative powers for many years, provided it is kept dry; but if placed in a proper medium, and afforded heat and moisture, it ramifies in all directions amongst the soil or other substances favourable to its growth. When this active state of vegetation commences, the spawn begins to *run*, as it is termed, and by adopting proper means, it may be propagated to a great extent. In some situations, and especially in old pastures, mushrooms naturally spring up in abundance, when the state of the weather proves favourable to the development of the spawn. Such being the case, some observations with regard to the circumstances under which they are produced may prove useful. They are most plentiful in soils that are naturally neither very stiff or clayey, nor, on the contrary, very loose, and especially so in old pastures having a compact surface from the treading of cattle. Where the cleanings of old mill-tracks have been thrown on land, mushrooms have been known to spring up most abundantly. In such situations they appear chiefly after midsummer, in July and August, but more numerous in September, especially when a succession of gentle rains has moistened the soil after a dry hot summer. A warm soil, and a calm, moist, warm, foggy atmosphere, are favourable to their natural production. During a period of great summer heat and drought, the surface of the ground where exposed to the direct rays of the sun is frequently of the temperature of 75° , and occasionally as high as 80° , to the depth of a few inches, and consequently whatever spawn may be there situated, must be subjected to that temperature. The spawn does not, however, assume that active state of vegetation which results in the production of mushrooms, till the soil is moistened by rain, and the high

temperature of both the earth and atmosphere is on the decline. When the temperature of the earth is between 60° and 65° , and the mean temperature of the air about 5° lower, mushrooms appear abundantly in suitable localities. Such conditions usually occur in September. From what has been stated, it appears that the spawn may be safely exposed to a temperature of 80° without danger of being destroyed; additional proof of this is afforded by the fact that, if inserted in melon beds, it increases or runs in the soil, whilst the melons are growing in a temperature of 80° ; and when the crop of melons is ripened off, the beds cleared and sufficiently watered, and the temperature lowered, a crop of mushrooms springs up. It appears that the spawn requires a higher temperature for its diffusion in its early progress, than it afterwards does when its vegetation is developed in the form of mushrooms, which is its final stage. Unlike most subjects of cultivation, light is not essential for the growth of the mushroom; for, although they grow naturally in open pastures, and dislike moist shady situations in which many other species of fungi abound, yet it will have been observed that in those pastures the development of the mushroom above ground occurs chiefly in the night. It is of course exposed to light during the day, and that may be of importance in perfecting the spores; but in other respects light is not essential. The mushroom, in fact, makes in the open pastures the bulk of its substance in the night, and even the salmon-coloured tinge of the gills is acquired in the dark.

Mushrooms, like other species of fungi, abound in nitrogen; this substance must therefore be considered a necessary element of its nutrition, and unless substances rich in nitrogen are supplied, its cultivation cannot be attended with success. Nitrogen is found in considerable quantity in the dung of horses and cows, and accordingly these substances are generally employed in the cultivation of the mushroom. They are subjected to fermentation, but this evidently must not be carried too far, otherwise the nitrogen would be driven off in the form of ammonia. The substances from which the mushrooms derive their principal supply of nourishment require to be coated with some earthy material, so as to absorb the ammonia which would be driven off by fermentation; they must also be rendered compact by treading or beating, in order

that the fermentation may be rendered slower, and consequently more lasting.

Preparation of the Spawn.—For the artificial production of mushrooms, it is necessary to be provided with good spawn. This may be purchased from nurserymen and seedsmen, or it may be collected and kept dry for use from amongst the materials of old hot-beds, horse-tracks, and dry places where cattle take shelter. It is easily known by its white colour and true mushroom smell. Brick-spawn is, however, generally considered preferable to that which is collected and kept in a loose state. It is so called from the materials being worked up and cut or moulded like bricks. For the formation of these, various substances have been recommended. The following have been found to answer very well, namely—fresh horse-droppings, cow-dung, and a little loam mixed and beaten up with as much stable-drainings as may be necessary to reduce the whole to the consistence of mortar. It may then be spread on the floor of an open shed, and when somewhat firm, it may be cut into cakes of 6 inches square. These should be placed on edge in a dry, airy place; and must be frequently turned and protected from rain. When half dry, make a hole in the broadside of each with a dibber, and so as to admit of about 1 inch square of good old spawn being inserted so deep as to be a little below the surface; close it with some moist composition similar to that of which the bricks were formed. When the bricks are nearly dry, make, on a dry bottom, a layer 9 inches thick of horse-dung, prepared as for a hot-bed, and on this pile the bricks rather openly. Cover with litter, so that the steam and heat of the layer of dung may circulate among the bricks. The temperature, however, should not rise above 60°; therefore, if it is likely to do so, the covering must be reduced accordingly. The spawn will soon begin to run through the bricks, which should be frequently examined whilst the process of spawning is going on, and when, on breaking, the spawn appears throughout pretty abundantly like a white mould, the process has gone far enough. If allowed to proceed, the spawn would form threads and small tubercles, which is a stage too far advanced for the retention of its vegetative powers. Therefore, when the spawn is observed to pervade the bricks throughout like a white mould, and before it assume the thread-like form, it should

be removed and allowed to dry, in order to arrest the farther progress of vegetation, till required for use. It ought to be kept in a dark and perfectly dry place.

Although the spawn made from the materials above recommended has proved excellent as manufactured by some persons, yet in the hands of others it may happen to fail. A portion may therefore be compounded according to one or other of the following recipes:—

1. Horse-droppings one part, cow-dung one-fourth, loam one-twentieth.

2. Fresh horse-droppings, mixed with short litter, one part, cow-dung one-third, and a small portion of mould or loam.

3. Equal parts of horse-dung, cow-dung, and sheep's-dung, with the addition of some rotten leaves or old hot-bed dung.

4. Horse-dung one part, cow-dung two parts, sheep's-dung one part.

5. Horse-droppings from the roads one part, cow-dung two parts, mixed with a little loam.

6. Horse-dung, cow-dung, and loam in equal parts.

From the above it appears that horse-dung and cow-dung are the principal ingredients in making spawn-bricks; the loam is added for the purpose of making the other materials hold together, it also absorbs the ammonia, which would otherwise fly off.

As there is so much difference of opinion as regards the substances employed in making spawn-bricks, and as different combinations of them are successfully employed, it will be worth while to endeavour to ascertain whether there is not one common principle in all of them, which is more especially essential for the growth of the mushroom.

The quantity of nitrogen which it contains being much greater than in other plants subjected to cultivation, it follows that it must be abundantly supplied; and accordingly all the substances usually employed for the spawn to feed upon, contain nitrogen in considerable quantity, as in the case of horse, cow, and sheep's dung. Analyses of these are of course subject to variation; but those made by Bous-singault, and other eminent authorities, may be considered a fair estimate of the percentage of nitrogen which the substances in question usually contain, and this is exhibited in the following table:—

SOLID EXCREMENTS.			URINE.
	Fresh.	Dry.	
Horse.....	0.54	2.2	1.55
Cow.....	0.32	2.3	0.44
Sheep.....	0.72	1.7	1.31

From the above it appears that in the solid excrements of the horse there is rather more than one-half per cent. of nitrogen, in that of the cow scarcely one-third per cent., while in that of the sheep there is nearly three-fourths per cent. The amount of nitrogen in dried horse and cow dung is nearly equal, and about one-fourth more than in dried sheep's-dung. The urine of the horse, it will also be seen, yields a large amount of nitrogen.

Although horse-dung contains a greater amount of ammonia, and ferments more readily than cow-dung, yet the heat of the latter continues longer, and on this account a mixture of the two may be employed for the growth of mushrooms.

Some recommend these substances to be used in a fresh state, others after they have undergone a considerable degree of fermentation. In the latter state, much of their nitrogen must have been driven off in the form of ammonia, so that there is no question as to the superiority of the fresh materials, if the heat generated by such can be controlled; but this is the difficulty. They can be disposed in thin layers, but then they do not afford such good produce as when in a greater mass. It may here be observed, that firmly beating the materials tends to lessen the fermentation, and by boring holes the heat is permitted to escape, but likewise the ammonia, which it would be desirable to retain for the benefit of the crop. Therefore, whilst the fermentation is going on, the beds should be covered with loam, by which much of the ammonia will be absorbed. For the same purpose a little leaf-mould might be spread over the surface of the dung, and then about 2 inches thick of loam, or of a compost of loam and cow-dung which has been frequently turned, and the different substances thoroughly mixed and incorporated.

The proper temperature can be maintained in pits during winter much more easily than in the ridges; but on the latter, mushrooms are still extensively cultivated by the market gardeners near London. Their mode of proceeding, as detailed by Mr. Cuthill, is very simple. The ridge is formed of dung as it is brought fresh from the London stables, and when the heat of the bed declines to 80°, pieces of spawn-bricks are inserted in the sides of the bed about 1 foot apart. "The bed is then moulded over, 2 inches thick, pressed with the feet, and afterwards beaten with the

spade. It is then watered, and beaten again with the spade, and smoothed down. The more the mould is pressed, the finer the crop is, and the more solid the texture of the mushroom."

Some market gardeners pursue a somewhat different system. Mr. Green allows the materials, chiefly stable-dung, to ferment a little, and but very little. He forms his beds on a hard piece of ground. They are 3 feet wide at the base, and are brought up to a very narrow ridge at top, to which the sides form a steep slope. The dung is made compact, and covered with mats or long litter to keep out the wet, and the spawn is inserted when the heat is declining below 80°. The sides are beaten as closely as possible, and the whole is then covered about 2 inches thick with a fine adhesive loam, worked to the consistence of mortar and beaten with the back of the spade, so that it becomes a compact casing to the bed. The heat is regulated more or less by the thicker or thinner covering of mats or litter, and if likely to become too cold, the bed is covered with warm litter. It should not be allowed to cool more than is proper, and then be warmed up by hot dung. Care must be taken to protect the beds from rain, for if they were allowed to get too wet, the spawn would not run. This is usually done with long litter or mats. Some construct roofs—a mode which should be adopted where boards, scantlings, or thatched hurdles can be procured. Mushrooms can be obtained in abundance for a good part of the year from beds formed out of doors as above described, or in some similar way; but the uncertain state of the weather occasions much more labour in regulating the covering than is required in growing them in a house where they are not exposed to extremes of heat and cold, and dryness and moisture.

A mushroom-house may either be span-roofed, or it may be constructed with a lean-to roof against the back of a forcing-house or other wall. A width of 10 feet is very good; it admits of a path 3 feet wide along the centre, and a bed 3½ feet wide on each side. If the north wall were built hollow, it would the better resist sudden changes of external temperature, and the same would be the case with the roof if it were covered with a thick coat of thatch, either straw or heath; but thatch, except in particular situations, is unsightly, besides being dangerous in case of fire.

Therefore slates will be chiefly employed instead, although in sunny weather they become hot, and transmit much heat to the interior. It will therefore be advisable, in the case of the mushroom-house, to have a double ceiling. The interior should be filled up with shelves, having in front upright ledges 9 inches deep, and 2 feet ought to be allowed from the bottom of one shelf up to that of the one next above it. Brick is a better material for the shelves than wood, for the latter sometimes becomes dry in consequence of the heat of the dung, and withdraws moisture without returning an equivalent of it from the moist air of the house. Moisture, however, is readily diffused through bricks, so that if their outside is moist from vapour in the air of the house, their inner surface in contact with the materials of the bed will not be injuriously dry. Where brick shelving has been tried, the crop of mushrooms has proved much superior to those on wood; and this being the case, the question is only one of expense as regards the first outlay. When we consider how soon decay in wood is induced by contact with fermenting materials in an atmosphere saturated with steam, and how rapidly decay proceeds when once it does commence, there can be no doubt as to brick-shelves being not only the best, but eventually the cheapest. Long experienced growers of good mushrooms on the ridge system, who considered mushrooms grown on Oldaker's plan of wooden shelves of poor quality compared with their own, nevertheless approved of brick-shelves, judging from the quantity and quality of the crop they had actually seen produced upon them.

Although for the greater part of the year a well-constructed mushroom-house will not require fire heat, yet, in the case of severe winters, it is necessary to have it at command. A little will suffice, especially as the doors should be made to shut close, and the windows ought to be furnished with close-fitting shutters. A small hot-water apparatus, with a flow and return 3-inch pipe, will answer the purpose. The pipes can be laid either in a channel under the footpath, where they can be covered with a grating or wooden trellis, or they may be placed along each side of the path and saddled with moveable evaporating troughs, made either of iron, tinned or galvanized, or of earthenware. If more vapour should at any time be required than will rise from these troughs, some of them may be removed, and

the hot-water pipe watered through the rose of a watering-pot. A dense steam can be still more readily produced by means of an inch pipe fitted into the top of a small boiler, which may be placed in an adjoining shed or other convenient situation.

The material chiefly employed for beds indoors, and in boxes, or on shelves, is the droppings of horses fed on corn and hay. They should be collected fresh, and laid in thin layers or small ridges in a dry place. The long litter ought to be shaken out and dispensed with; but a portion of the short litter may be retained, provided it has been well moistened by the urine of the horses. These materials should be frequently turned and maintained in an incipient state of fermentation. In order that the ammonia may not be lost, the dung may be mixed with a little rather dry, friable maiden loam. Some, indeed, beat up together, with a piece of wood similar to that used for mortar, horse-dung, loam, old mushroom-bed dung, and half-decayed hot-bed leaves, containing traces of spawn; and these, when well incorporated, are placed in the mushroom-house in successive layers, and each layer, about 3 inches thick, is beaten firm. When about 10 inches thick, the surface of the beds is covered with about 2 inches thick of loam, and if likely to get too hot, holes are bored. Beds so formed produce well without the introduction of brick or cake spawn; but, in case of failure, it is always advisable to be provided with some of it.

Mr. Forsyth recommends horse-droppings to be collected and dried a little in an open shed, a stratum of loamy turf, 2 or 3 inches deep, to be placed in the bottom of the bed, and then three layers of droppings, each layer being rendered as compact as possible. When the mass heats, holes are bored 9 inches apart, and as deep as the loam, and when the heat declines to 80° the holes are partly filled up with loam and horse-droppings mixed; a piece of spawn about the size of a hen's egg being inserted in each, they are then filled up level with the surface. If the beds are to be of considerable thickness, say 1 foot or more, then it is well to mix the materials with loam, in order to prevent the fermentation becoming too violent; but when they are chiefly composed of droppings, they must be made thinner, in which case they will not continue so long in bearing.

The spawn should be introduced a little

below the surface when the heat is 75° , or on the decline from 80° , a temperature which the materials ought never to exceed. The surface of the bed must be immediately covered thinly with loam, and in a week or ten days this covering should be made up to 2 inches thick. When put on, it ought to be as warm as the materials of the bed. The whole is then covered with hay or litter.

The temperature of the house should be kept at between 60° and 65° till the mushrooms appear; afterwards it may be 60° , or not lower than 55° . When in bearing, the productiveness of the beds is sometimes injuriously affected by watering. When moisture is needed, it is best to well moisten the covering of hay and litter, but not the beds themselves. The water used for this purpose must be of the temperature of 80° .

MUSTARD, CRESS, AND RAPE.—These, when in constant demand, may be sown once or twice a-week, from the end of October to the middle of March, beginning and leaving off sooner or later according to the season. The seed should be sown thickly in shallow boxes or pans, placed in any structure where a temperature of from 55° to 70° is maintained, or on an old hot-bed. It must be just covered with fine soil, indeed no other covering than a damp mat may be used, the object of covering being merely to prevent evaporation. When the seed vegetates the mat is removed, in order to allow the leaves to acquire their proper colour. On an extensive scale, the seed may be sown on old tan spread thinly in any place where the necessary amount of heat, light, and moisture is at command.

ONIONS.—When young onions are required in winter for salads, the seed may be sown thickly in pans or boxes of light rich soil, placed near the glass in a vinery or other structure where a temperature of from 55° to 65° is maintained. The onions are drawn for use in a very young state, and a sowing may be made every fortnight if a constant succession is required.

POTATO.—The Ash-leaved Kidney, Fox's Seedling, Early Manly, Rufford Kidney, and Early Shaw are all well adapted for forcing; but there are many other early varieties which will answer nearly if not quite as well.

Potatoes are forced in various ways—on hot-beds, in pits, and in pots placed in a vinery, peach-house, or other structure where there is a moderate degree of heat with plenty of light.

Culture on Hot-beds.—The tubers which are to be used for sets are placed close together on a gentle hot-bed, or on the floor of a cellar to vegetate, and when they have made shoots 3 or 4 inches long, they may be planted on a moderate hot-bed covered with 8 inches of good light soil. The sets may be planted 4 inches apart, in drills 5 inches deep, and 1 foot from each other, and covered at first with $1\frac{1}{2}$ inch or 2 inches of light soil; but afterwards, when the stems grow strong, the drills can be filled up level with the rest of the surface. After planting, water should be given sparingly; but as the plants increase in size, it may be more liberally supplied. Air must be freely admitted whenever the weather is favourable; but at night, and in frosty weather, the sashes will require to be covered with straw mats or other protecting materials. A mild and nearly uniform temperature should be maintained. The tubers may be used when they are about 1 inch in diameter, the largest being taken first, and the small ones being left to afford a supply in succession.

According to Mr. Cuthill, the following is the mode adopted by the London market gardeners for obtaining early potatoes:—“A long bed, 5 feet wide, is dug out to the depth of 2 feet. This trench is filled with hot dung, on which 6 inches deep of the surrounding mould is put. Middle-sized whole potatoes are used for planting; they are placed in close succession along the bed, covered with 2 inches of mould, hooped, and covered over with mats and straw. In about a month they will have sprouted; frames are then got ready, placing 2 feet of hot manure along the whole line of framing, which is sometimes 100 yards in length; the mould is put on to the depth of 8 inches; the potatoes are carefully taken up from the striking bed, all shoots are removed except the main one, and they are planted 4 inches deep. Radishes are then sown thinly over them, covering lightly with mould. When the haulm of the potato has grown to about 6 inches in height, the points are nipped off; this is done in order to give the radishes fair play, and although it may stop the growth for a few days, still the crop is always excellent. The plants are never moulded up, a plan which weakens the potato more than anything else. After planting, nothing more is required but to admit plenty of air, and give water; the crop is not dug up until it has come to maturity. The above is

the treatment potatoes receive, but they are also grown largely in hooped beds in the open ground. In the latter case the tubers are sprouted, as I have before mentioned. The beds or ridges are dug out 2 feet deep, in January, filled with hot dung, and covered with the surrounding mould to the depth of 10 inches. The potatoes are taken up and planted 5 inches deep, and above all, radishes are sown. The ridges are then hooped over, allowing about 2 feet of space in the middle, between the mould and the hoop. They are covered with mats and straw; but as soon as the radishes come up they are uncovered daily, and covered again every night. This is continued till the potatoes are ready for digging, in May, for sometimes large losses are occasioned by a sudden change of weather on cold April nights. Nothing more is done to the hooped beds, beyond attending to them with water."

Culture in Pots.—This is very simple; it is merely necessary to plant the sets in 8 or 11 inch pots, filled to within 3 inches of the top with light rich soil. The pots may then be placed near the glass in a vinery, peach-house, or pit, where a temperature of from 50° to 60° is maintained. With the exception of watering, and putting more earth in the pots as the plants advance in growth, no further attention is required. It is advantageous to excite the sets previous to planting, as already recommended.

Forcing may be commenced in December, and succession crops planted in January and February.

PURLANE.—This, when required early in the season, may be sown on a hot-bed from January till the end of March. The bed may be about 15 inches thick, and should be covered with 6 inches of rich vegetable mould. On this the seed ought to be scattered thinly, and slightly pressed in with the back of the spade; a temperature of 60° or 65° should be maintained. The plants may be cut twice, and after the second cutting, the soil having been renewed, seed may be again sown.

RADISH.—The best sorts for forcing are the Oblong Rose-coloured, Wood's Early Frame, and the Early Frame Scarlet, among the long rooted varieties; and the Red and White Turnip-rooted radishes. The seed should be sown in light rich soil, laid to the thickness of 8 or 9 inches, on a moderate hot-bed, or in a pit where a temperature of from 55° to 65° is

maintained. About an ounce of seed will be sufficient to sow 25 square feet. If the plants come up too thickly, they may be thinned to about an inch apart; afterwards, thinning will be effected sufficiently well by drawing the most forward for use. Gentle waterings should occasionally be given, and air admitted at every favourable opportunity; but the sashes must be covered at night, and in frosty weather, with straw-mats, or other protecting materials. A sowing may be made every fortnight, from the beginning of November till the middle or end of February, and the crop will generally be fit for use about six weeks after sowing. Radishes are frequently forced along with carrots, or between the rows of endive and lettuce.

RHUBARB.—The Tobolsk, Mitchell's Royal Albert, Randall's Early Prolific, and Myatt's Linnæus, are all excellent sorts for forcing. It would also be desirable to have some of the Elford, on account of its fine colour. Rhubarb is forced in the open ground, or in pits, cellars, or other structures, where a sufficient degree of heat is maintained. In the open ground, forcing is frequently effected by covering the roots with sea-kale pots, boxes, or flower-pots, which are afterwards surrounded with hot dung, or a mixture of litter, stable dung, and leaves. Another mode which is pursued by the market-gardeners near London "consists in digging long pits, to the depth of 2 or 3 feet, introducing 18 inches of hot dung, and then packing the roots closely together in a little mould, covering the crowns with hoops, or with 6 inches of straw, then hurdles or mats, and finishing with 6 or 8 inches of straw, the amount of the latter depending on the severity of the weather. In this way strong well-flavoured stalks are produced, provided the weather is dry. The colour is bright red, and the leaf is always very small."—(Cuthill's *Market Gardening round London*.)

All the above modes are, however, attended with considerable trouble and expense, and give the ground a littery and unsightly appearance; moreover, the quality of the produce is frequently much deteriorated by wet. For these reasons, forcing in houses is greatly to be preferred; not only is the heat more at command, but the quality of the produce is not dependent on the state of the weather. Rhubarb may be forced in any structure where a temperature of from 55° to 65° is maintained; a mushroom-house, the floor of a vinery or peach-house, or a pit, will be very suitable.

Where accommodation of this description is not at command, the roots may be placed on dung beds in a shed, or even in a warm cellar. Roots from two to five years old are the best for forcing, but in default of such, strong roots of one year's growth may be employed. The reason of the preference being given to the former is that they contain a greater amount of organizable matter for the larger formation of leaves and stalks. They may be taken up carefully any time after the decay of the leaves, and placed close together in the spot where they are to be forced. Some light mould should then be worked in among them, and a thin layer of soil spread over the whole, in order to retain a sufficient amount of moisture for vegetation. Afterwards, if the mould get too dry, a gentle watering may be given. No other care will be required. Sometimes the roots are taken up in autumn, potted, or more frequently packed close together in boxes, and kept in a shady situation till required for forcing, when they may be placed in a mushroom-house or vinery. In this way, by bringing in a quantity of roots every three weeks, a constant succession may be secured with little trouble.

Forcing may be commenced in the end of November, and continued till stalks are produced in the open ground.

SEA-KALE.—This is easily forced. In order that it may become blanched it requires to be grown in the dark. A little heat is sufficient to excite its vegetation, for, with a mean temperature of 42° , it pushes naturally in the open ground, and when the mean of the air and of the soil reaches 55° , the growth is as vigorous as can be desired, and therefore in forcing, this mean temperature ought not to be exceeded. In cases of emergency, when produce must be had in a certain limited period, 60° may be applied; but this should be the maximum. Mills recommends a gentle heat, adding—"the milder it is the finer will be the produce." If forcing is to be carried on where the plants are established in the open ground, the soil ought not to be allowed to get frozen in the autumn or winter previous to forcing. It is easy to prevent this by a covering of litter; but if the soil is allowed to get frozen, it takes much heat to raise the temperature to even 42° , which we may term the starting point in forcing this vegetable, for at this temperature it will be in a manner dormant. Top and bottom heat should correspond, for at

the time of the year when sea-kale pushes naturally, the average temperature of the air and that of the earth very nearly correspond. In commencing to force we may raise the bottom heat 5° , or to 47° the first week, to 50° the second week, and then increase by one degree a week till produce fit for cutting is obtained, which will be in the course of six or seven weeks from the commencement of the process. It will be apparent that the above small amount of heat may be obtained in various ways, and in different situations, in the open ground, by tan, dung, or leaves, or by the last two materials mixed, and in houses or pits by flues or hot-water pipes.

The time to commence forcing depends on the period at which produce will be required. If this should be the third week in December, from plants forced in the open ground, they must be cleared of decaying leaves in the end of October, and the soil about the crowns forked over, and made fine. A portion of the plants may be covered to the depth of several inches with light soil, sand, or coal ashes, and a succession to those which are not so treated will by this means be secured. The others should be covered with sea-kale pots, or large garden pots, and over these must be laid a covering of dung, or preferably, a mixture of dung and leaves.

A mode of forcing extensively practised by the market-gardeners near London is detailed by Mr. Cuthill. Essentially it is as follows:—When the plants are removed in spring, after having been forced, the *thongs*, or long pliable portions of the roots, are cut off, and as soon as the cuts become dry, the pieces are planted out for the summer, to be taken up for forcing in the following November. All the small bnds round the principal one are pared off, so that the latter may make a stronger sprout. Some growers cut off the prongs, or end roots, in November, when the plants are taken up to be forced. The pieces taken off are cut in lengths of 4 inches, and thrown in a heap till spring, when they are planted out for the summer, and taken up before winter for forcing, planting them thickly in beds, hooped over, and covered with straw to the thickness of from 4 to 6 inches. There can be no question as to the superiority of plants raised from cuttings of roots that have not been forced, as compared with those from plants that have undergone that process; for the production of the blanched shoots must

greatly exhaust the proper juices stored up in the roots, whilst the latter cannot derive from growths not exposed to the light any equivalent return. On the other hand, taking off the smaller parts from roots about to be forced, and thus reducing them to truncheons, must, to some extent, lessen the vigour of the sprouts. The question is, whether, thus treated, strong plants from good cuttings give a better produce than weaker plants from exhausted cuttings, but forced with all their roots. We think the probability is in favour of the former. But instead of adopting either, it would be better to raise an abundance of plants, from which unexhausted cuttings could be obtained, to produce plants for the purpose of being forced, without mutilation.

SORREL.—The best sort for forcing is the Belleville Sorrel. In the middle or end of November the roots should be taken up with small balls, and planted in rich mould on a moderate hot-bed, or in pots or boxes, in any place where there is a bottom-heat of 50° , and an atmospheric temperature of 55° . Forcing may be continued till the end of February or beginning of March.

THE SWEET POTATO or BATATAS (*Convolvulus Batatas*, L.—*Pentandria Monogynia*, L.; *Convolvulacæ*, D. C.; *Convolvulacæ*, Lind.)—is a perennial plant, a native of the West Indies and South America. The tubers, called potatoes by the old writers on gardening, having a sweet agreeable taste, were imported into this country from Spain, and used as a delicacy long before the introduction of the potato (*Solanum tuberosum*). The plant is extensively cultivated in the warmer parts of America, and will even succeed in the open air as far north as New York. It is also grown in the south of France, but in Britain to produce useful tubers it requires the protection of glass; and for this reason, as well as on account of the difficulty there is in preserving the tubers through the winter, it is but little cultivated. There are several varieties; amongst those known in France the best are the Long Red, the Rose-coloured Malaga, the White of the Isle of France, the Yam Sweet Potato, the tubers of which sometimes weigh 8 lbs., and the Purple, which attains a large size and keeps better than the other kinds.

The sweet potato is raised from seed, but, as in this way several varieties may be produced from the seeds of the same plant, propagation is usually effected by means of the

tubers. In February, or the beginning of March (in April at New York), these are placed close together, but without touching each other, on a thin layer of mould, on a moderate hot-bed, and covered with 4 inches of fine soil. If only a few plants are required, the tubers may be planted in pots plunged in a hot-bed, or placed on the flues of a vinery or peach-house. When shoots about 4 inches in length are produced, they are taken off and planted about 4 inches apart, on a moderate hot-bed, or potted singly into small pots, and placed in heat, keeping them, in either case, near the glass. In the beginning of May the young plants may be planted out 2 feet apart, on a slight hot-bed, shading till again established, and giving gentle waterings at the root, as may be necessary.

Tubers fit for use may be obtained in August, and the whole crop may be taken up in October, but in doing so great care must be taken not to bruise the tubers, otherwise they will soon decay. Only the soundest should be selected for keeping; and these having been placed so as not to touch each other, in dry sand or moss, in boxes, or earthenware jars, may be kept through the winter in a dry airy place, with a temperature of 50° .

TANSY may easily be forced. It is only necessary to pot the roots, and place them in a temperature of 55° or 60° , or to plunge them in a moderate hot-bed.

TARRAGON.—In order to have tarragon in winter, roots should be taken up in autumn, and planted in light rich soil in pots or boxes, which may be introduced into a house with a temperature of 55° or 60° , in succession, from the beginning of December till the plants in the open ground produce leaves. Roots may also be placed on a moderate hot-bed, and covered with vegetable mould.

TOMATO.—Beyond forwarding for planting out, either into the open ground or into pits, the tomato is very rarely forced in this country. Fruit may, however, be produced as early as April or May, by sowing in October, in pots of light rich soil, placed in a pine-stove, shifting into larger pots as the plants increase in size, stopping when a sufficient number of fruit is produced, and training against some support, so as to expose the fruit fully to the light.

For very early tomatoes the market-gardeners of Paris "sow in September in pots, which are placed in a pine-stove, or plunged in a hot-bed, and prick out in January; but in

ordinary forcing, the seed is sown on a hot-bed in January, and when the young plants have acquired sufficient strength they are pricked out into another hot-bed. A few days after planting they commence to give a little air to strengthen the plants. In February or March a hot-bed, 20 inches thick, is prepared, so as to afford a heat of from 68° to 77°, the frames are put on, and a layer of vegetable mould, 10 inches in thickness, is spread over the dung. The frames are surrounded by a lining which is turned when necessary, and as soon as the bed has cooled down to the proper temperature, four tomatoes are planted under each light. The sashes are then put on, and covered up at night with straw mats. When the plants have somewhat advanced in growth, two branches are chosen on each, and pegged down. The others are all cut off, and when a sufficient number of flowers have been produced, the branches are stopped. Afterwards all fresh shoots are pinched or removed; gentle waterings are given, air is admitted on bright days, the frames are raised up as may be found necessary, and, when the fruit begins to redden, all leaves which tend to shade it are removed, in order to hasten the ripening process, and render it more complete. The earliest sown tomatoes commence to ripen in the beginning of April; the January sowing in May."—(*Culture Maraîchère*.)

II.—FRUIT.

APRICOT.—The apricot was formerly considered as difficult to force as the cherry, or even more so. Blossoming in the open air at a cool period of the season, it is adapted for bearing only a low temperature at that stage of its vegetation, and previously. Its buds begin to swell by the influence of warm sun through the day, the nights at the same time being usually frosty. It is therefore not to be supposed that a tree, of which the vegetation progresses under such circumstances, will bear with impunity the heat which might be safely applied to start the vine, for example, into leaf. The Royal Muscadine, one of the earliest grapes, generally breaks into leaf on a south wall in the first week of May, by which time the young fruit of the apricot usually attains a considerable size. The same sort of vine flowers when the maximum temperature of the day is about 68°, and the minimum at night 46°, and it would bear a much higher temperature than this, whereas the apricot

flowers, with a maximum of 54°, and a minimum of 35°. It therefore appears that the apricot flowers with a day temperature of 14°, and a night temperature of 11° below that in which the vine flowers. This being the case, it may be fairly assumed that the apricot would suffer if it were forced into leaf and flower along with the vine; and attempts to do so would lead, as they have done, to the supposition that the apricot is not adapted for being forced. If the vine were kept in no higher temperature than that in which the apricot flowers, its vegetation would scarcely be moved; therefore a wide difference must exist between the habits of the two plants, so that what would scarcely excite the one would over-excite the other, in the early stage of its vegetation, at least.

The apricot, however, will bear to be brought forward, agreeably to the temperature experienced in the open air in our best seasons, and therefore somewhat higher than that of the average, which we have taken for data as above. In forcing, we may therefore commence with 50° maximum, and 40° minimum, for the first two weeks; third week, 55° maximum, and 42° minimum; fourth week, 58° maximum, and 55° minimum, and the fifth week, if the tree is in flower, the temperature may be continued about the same, with plenty of air. When the wood-buds begin to open, and shoots to push, care must be taken that they do so rather slowly than otherwise, in order that the parts of fructification be not robbed of the sap which would otherwise flow to them. We have seen that a comparatively low temperature is amply sufficient for the perfect development of these parts; and it has been frequently observed that the fruit does not set so well when the tree is subjected whilst in blossom, and before the fruit is well set, to a comparatively high temperature, in consequence of which leaves and shoots are rapidly produced; for, when this is the case, the sap flows with greater force towards these than to the parts of fructification on which its force had previously been almost entirely concentrated. By a moderate temperature give the blossoms time to expand, and the parts they inclose to make slow and substantial growth; at the same time take care that they are not stinted by cold. But the temperature must not be raised to a pitch that would expand the foliage; do not by any means drive the leafing too close to the flowering. At-

tention to this will insure a well set crop, provided the tree is in good condition. After the fruit is set the temperature should be gradually raised, and kept always higher when the weather is clear than when it is dull. When the fruit is stoned the temperature may then be raised to 70° by day, and 60° by night; and in ripening off the day temperature may be allowed to reach 70° or 80° by sun heat.

The Dutch force apricots successfully, as, indeed, they do most things in their pits, heated by dung. In the *Journal of the Horticultural Society*, vol. ix., there is an account of a trial of their method, by Mr. Tatter, of the Royal Gardens of Herenhausen, near Hanover. The tree employed, it is worthy of remark, had been, from its earliest age, transplanted every two years, and had thus formed an abundance of fibrous roots, and was well furnished with fruit spurs. It was planted in spring, outside a pit, into which the branches were introduced, and trained under the sashes. These have an elevation of about 33°, their lower end being within a foot of the ground level. At 18 inches below the sashes, and parallel to them, there is a wooden trellis on which the branches are trained. At 9 inches below the trellis, and parallel to it, there is a close boarding which forms a partition between the fermenting dung in the pit and the tree.

The forcing was commenced on the 6th of January, and the following is a record of the temperatures to which the tree was subjected, and the results which were produced on its vegetation:—

Week Commencing	Temperature.		State of the Tree.
	By Day.	By Night.	
Jan. 6,	43°-34°	41°-34°	Total rest in the buds.
„ 14,	50°-41°	43°-36°	{ Buds begin to stir about the 16th.
„ 21,	59°-50°	50°-41°	{ Swelling of the buds progresses most in up- per part of the tree.
„ 28,	63°-59°	54°-45°	—
Feb. 8,	54°-50°	50°-45°	{ In flower from the 8th to the 15th; fruit set on the 12th.
„ 15, } to March 7 }	68°-63°	54°-50°	{ Woodbuds shoot out; leaves slowly unfold; petals fall about the 18th, and young fruit swell.
March 8-31,	59°-54°	54°-50°	{ Fruit the size of a hazel nut; leaves large; towards the 27th the stones begin to harden.
April 1, to } June 26, }	68°-63°	59°-54°	{ The fruits now grow rapidly, and towards the 29th of April the greenish colour changes to a yellowish white. The first fruits ripened on the 27th of May, and altogether 290 well-grown fruits were brought to ma- turity.

The tree in question was planted in the spring previous to its being forced, in the expectation of more certain success than if it had been planted, as in the Dutch practice, at the time of commencing forcing. A trench outside the box inclosing the roots was completely filled with dung and leaves, in order to maintain a moderate degree of warmth about the roots, and induce them to produce fibres. Inside, the branches derived artificial warmth also from fermenting materials introduced into the body of the pit, below the wooden portion. The temperature was reduced, when necessary, by giving plenty of air, even in the night. The diminution of temperature in the night, Mr. Tatter observes, is indeed essential. The tree would, in the night time, without light, under a high temperature, be drawn up, would send out long weak shoots, and consequently bear small and bad fruits. We may add, that if the temperature by fire heat be kept low at night, before and during the time of flowering, it may be allowed to rise pretty high by sun heat. Brought forward by a uniformly high temperature, the blossoms of the apricot will fail in setting; on the other hand, with one uniformly low, the vegetation of the tree will not be sufficiently excited; the range of temperature, however, between the lowest at night and the highest in the shade during the day should be tolerably uniform, and as much as 12 degrees.

CHERRY.—Forcing cherries was formerly considered a precarious operation. It was often the case that the blossoms fell prematurely without setting fruit, or if it did set, it was imperfectly, and the young fruit dropped off about the time of stoning. It is now understood that in many instances such failures were occasioned by too high a temperature, with insufficient air, in the early stage of the process, more especially during the blossoming period. The natural circumstances under which the cherry expands its buds and flowers, sets fruit, and brings it to maturity, does not appear to have received the due consideration which it has done of late years, by many eminent cultivators—for example, by Mr. Ingram, of the Royal Gardens, Frogmore, and Mr. Fleming, of Trentham, whose forced productions of this fruit we have seen year after year invariably excellent.

In the open air, near London, and in an average season, the May Duke cherry flowers in the last week of April. The vegetation of

the trees moves but slowly at the beginning of March. The average highest day temperature in the shade, in each successive week, from the 1st of March to the 2d of May, progresses as follows:—

1st Week.	2d Week.	3d Week.	4th Week.	5th Week.
48·70°	50·70°	50·78°	51·09°	54·92°
6th Week.	7th Week.	8th Week.	9th Week.	
56·03°	57·12°	58·60°	61·12°	

In seasons more favourable than the average, the maximum temperature is as much as 5° higher than in the above series, and the May Duke cherry flowers as early as the middle of April. We may therefore increase the above by 5°, or a little more or less occasionally, so as to regulate the progressive increase of temperature. The night temperature during the above period averages 19° below the day; but in the climate of Paris, where cherries succeed well, and ripen early in the open air, the range of temperature between the highest in the day in the shade, and the lowest at night, is much less, frequently not more than 10° or 12°. Adopting the latter range in forcing we should have the highest without sun heat and the lowest at night, in the respective weeks, as follows:—

Highest in the day—

1st Week.	2d Week.	3d Week.	4th Week.	5th Week.
53°	55°	56°	57°	59°
6th Week.	7th Week.	8th Week.	9th Week.	
61°	62°	64°	66°	

Lowest at Night—

1st Week.	2d Week.	3d Week.	4th Week.	5th Week.
41°	43°	44°	45°	47°
6th Week.	7th Week.	8th Week.	9th Week.	
49°	50°	52°	54°	

Mean—

1st Week.	2d Week.	3d Week.	4th Week.	5th Week.
47°	49°	50°	51°	53°
6th Week.	7th Week.	8th Week.	9th Week.	
55°	56°	58°	60°	

The above rate of temperature represents a good natural climate for the cherry. At the commencement of forcing, however, the temperature may be 60° during the day, and 45° at night, in order to start the vegetation of the tree, but it must be lowered when the blossom buds are about to open. After the fruit is stoned the temperature may be gradually raised to 70° by day, or 75° by sun heat, and 60° at night. Subjected to the preceding temperature, with an occasional rise of 5° more by sun heat, or even of 10°, provided the weather is such that abundance of air can be admitted at the same time, the trees will be in bloom in the sixth or seventh week. In dull cloudy weather the

temperature should be lowered a few degrees, and it may be raised several when there is plenty of sunshine. It is easy to distinguish an overforced vegetation from that which is natural. In the former case the flowers are small, the petals thin, the stamens and pistils weak and slender as compared with these parts when developed under natural circumstances, or those which are forced in accordance with such. The foliage on an overforced plant may be broad, but its substance is thin, and altogether the plant has not that robust appearance which indicates a substantial vigorous growth. It is therefore necessary to watch the progress of vegetation, in order to prevent a too rapid development by lowering the temperature, or by giving more air.

The variety of cherry best adapted for forcing is the May Duke; the Royal Duke is also an eligible sort. The Duke cherries are of more compact growth than the Bigarreau tribe, and they set better; nevertheless, a few of such kinds as the Elton and Knight's Early Black may be forced for variety where space can be afforded. The trees should be worked on young stocks, and removed in autumn, after they have made their first shoot from the graft or bud. Tap roots, or other large roots, should be pruned back, and the leading shoot ought to be shortened to 9 inches above where it was worked. The tree must be replanted in tolerably rich soil, and in the following summer it should undergo a judicious summer pruning, which chiefly consists in stopping shoots that are likely to become too strong for the others, and if vigorous, the lateral shoots may be shortened to six buds in the end of June.

The soil for the pots should be good turfy loam, of a friable nature, mixed with compost of light loam and rotten dung. If the plants are small, they may be put into 12-inch pots in the first instance, and after having been a year established in these, they may be shifted into 15-inch pots early in autumn. When shifted, they should be plunged in some loose or even very slightly fermenting materials that will keep the pots warmer than if they were freely exposed in the open air, and thus encourage the formation of fresh roots, which will be ready to act when brought into heat. The soil of the pots should be protected from snow-showers and cold rain. Occasionally, trees have been taken up in autumn with balls, potted, and forced in the following spring; but those which have been established a year

in the pots are to be preferred. Such only as are well furnished with blossom-buds should be selected. The house or other compartment in which the trees are to be forced, ought to be thoroughly cleaned, and put in proper condition to receive the plants in the beginning of December, if fruit be required very early in the season. During the first and second week it may be kept nearly close; for the buds being then in a dormant state, a free circulation of air is not of much consequence; but as vegetation advances, such become absolutely necessary during the day, and even at night when the weather will permit. When the trees are coming into bloom, and till the fruit is set, air must be copiously supplied. About the middle of December, or in the third week of that month, fires should be lighted; and if a proper temperature be maintained, the fruit ought to be ripe in the end of March.

Water must be regularly supplied to the roots according as it is wanted; its temperature should be quite equal to that of the air in the house. The trees ought to be kept well syringed with water not colder than the maximum temperature of the air of the house. When the trees are in bloom, however, syringing must be left off till the embryo fruit is set, after which it should be resumed till the fruit is approaching maturity, when water ought to be given very sparingly. After the fruit is gathered, the trees should be duly supplied with water at the root, and the foliage kept well syringed till the wood is mature.

In order to have fine and large fruit, the latter must be thinned. This should be done by removing with seissors the small fruits as soon as they can be distinguished from those beginning to take the lead. Weak manure water may be occasionally given after stoning, but not when the fruit is approaching maturity, otherwise the flavour will be deteriorated. Frequent top-dressings are highly beneficial, for by the water passing through them, particles of fresh soil are conveyed down to the roots at every watering.

After midsummer, when the weather is so warm as not to give a sudden check to the vegetation of the trees, they may be placed out of doors where the sun's rays will not act upon the pots; or the plants may be turned out of the pots and planted in some light soil, where they may remain to recover for the ensuing season, and they may then be repotted in autumn in pots a size larger.

The forcing of trees planted out in houses is conducted on the same principles as in the case of those in pots, as regards temperature and light. Moisture will of course require to be frequently supplied to the roots, and this point should be particularly attended to, for the leaves of the cherry evaporate a great deal; yet any approach to an excess of moisture about the roots must be guarded against. Care should, however, be taken that there is no deficiency of it when the fruit is swelling, because none ought to be given during the ripening process.

THE FIG (*Ficus Carica*, L.—Polygamia Dioecia, L.; Moraceæ, Lind.) is a native of the south of Europe, Northern Africa, and Western Asia; and we find in the Scriptures ample record of its cultivation in the earliest ages of the world, and of the estimation in which the fruit was held. The figs of Athens were celebrated for their exquisite flavour; and it is said that Xerxes was tempted by them to undertake the conquest of Attica.

The tree, although remarkably soft-wooded, lives to a very great age—several centuries in mild climates; and even in Britain, trees of the White Marseilles variety, brought to this country by Cardinal Pole in 1525, were lately covering a large extent of wall, and bearing abundantly in the garden of the Archbishop of Canterbury, at Lambeth Palace. On the south coast, in various parts of Sussex, as at Arundel and Tarring, the fig grows and bears most abundantly as a standard. In parts of the country, where the rigours of severe winters are not mitigated by the sea-breeze, fig-trees, if not protected, are occasionally killed down to the ground; but although this be the case, established plants push up again from the roots. When the thermometer, for several successive nights, falls to about zero, the old wood is killed, and at 10° Fah. the extremities of the young shoots are mostly destroyed. Like the vine, it can bear, as it does in the countries to which it is indigenous, a very hot summer, but, as appears from the above, not a severe winter, such as the wood of the vine withstands uninjured, if previously well matured.

The varieties of the fig are exceedingly numerous in the countries where it is extensively cultivated, as in the Ionian Isles, Italy, and Provence; but many of them have not been grown in this country, or at any rate their adaptation to our climate has not been fully

ascertained. We shall, therefore, only notice some of the best of those which have been proven.

I.—FRUIT BLACK, OR DARK PURPLE.

1. **BLACK ISCHIA**—syn. Blue Ischia, Early Forcing.—*Fruit* middle-sized, roundish obovate; skin dark purple, almost black; flesh deep red; flavour rich and excellent. The tree is a good bearer, and comparatively hardy.

2. **VIOLET**—syn. Figue Violette.—*Fruit* large, round, and a little compressed at the summit, elongating towards the stalk; skin thin, dark purple or violet; flesh red at the centre, rich and sugary. This is one of the few sorts of figs that ripen a second crop in the neighbourhood of Paris. In forcing, a second or third crop may be obtained from it in the same season.

3. **EARLY VIOLET**.—Mr. Rivers describes this as small, brownish-purple, very hardy, and bearing abundantly, often giving three crops in one season in the forcing-house.

II.—FRUIT BROWN, OR DULL PURPLISH BROWN.

4. **BRUNSWICK**—syn. Madonia, Hanover, Brown Hamburg, Bayswater, Clementine.—*Fruit* very large, oblong-obovate or pyriform; stalk short and thick; skin pale yellowish green where shaded, dull purplish-brown next the sun, intermixed with small pale brown specks; flesh pale next the outside, reddish-brown at the centre, tolerably rich and sugary. This variety is hardier than most others, and is therefore adapted for the open wall; but it does not answer well for forcing, the fruit being more apt to drop than is the case with shorter-necked varieties. The leaf is large, but is very deeply lobed or divided into narrow segments.

5. **BROWN TURKEY**—syn. Brown Naples, Italian, Jerusalem, Murrey, Lee's Perpetual, Howiek, Walton, Ashridge Forcing, Early, Fleur rouge; Purple, Common Purple, Blue, Large Blue, Blue Burgundy, and Blue Ischia of some.—*Fruit* large, turbinate, or short pyriform, with a grooved surface, obtuse at the stalk, which is short and thick; skin brown, with sometimes a faint purplish tinge next the sun; flesh tinged with red at the centre, rich and sugary; ripens early. The tree is a most abundant bearer, and one of the hardiest known. It is the best for out-door cultivation, and it also forces well.

6. **PREGUSSATA**.—*Fruit* large, oblate, or turbinate; stalk short and thick; skin dark brown, with a purplish tinge, and sprinkled with pale dots; flesh red, very sweet and rich. The tree is a good bearer, and well adapted for forcing. This excellent variety was sent from the Ionian Isles to the Horticultural Society of London by Dr. Skey.

7. **BROWN ISCHIA**—syn. Chestnut-coloured Ischia.—*Fruit* middle-sized, obovate; skin brown; flesh purplish red, sweet and rich; ripens early. It succeeds on the open wall in a good situation, but is not quite so hardy as the Brown Turkey.

III.—FRUIT GREEN, PALE YELLOW, OR WHITE.

8. **WHITE MARSEILLES**—syn. Marseilles, White Naples, Pooock, Ford's Seedling, White Standard, Figue blanche.—*Fruit* large, roundish obovate, or somewhat turbinate, slightly ribbed; stalk short and thick; skin pale green, becoming yellowish-white when the fruit is at maturity;

flesh very succulent, sweet and rich. Ripens and answers well for forcing.

9. **NERU**.—*Fruit* small, roundish obovate, sometimes elongated and tapering; skin pale greenish-yellow; flesh red, exceedingly juicy, rich, and sugary. This applies to the second crop, for Mr. Knight could never ripen the first to perfection. He forced this variety in pots, which were introduced into heat in February; and when the fruit had acquired half its size, fire-heat was discontinued, and the plants were subjected to confined solar heat. When the fruit began to acquire maturity, much air was given, and in dull weather artificial heat was to a small extent again employed to prevent the fruit from becoming mouldy. It requires less heat than other varieties, and has been found to answer on the open wall.

10. **WHITE ISCHIA**—syn. Green Ischia.—*Fruit* small, roundish obovate; skin pale yellowish-green, very thin, and semi-transparent, acquiring a brownish tinge at maturity; flesh purplish-red, sweet and rich.

In addition to the above we ought to mention a sort called the Madeleine, which, on the authority of M. Leroy, of Angers, is very excellent, and the most productive fig cultivated in that part of France. The fruit is described as large, oblong, of a gray or brown colour, with white flesh of excellent quality.

Propagation.—This is readily effected by seeds, layers, cuttings of the roots and tops, suckers, and by grafting.

Seeds are easily raised by sowing in pots or pans filled with leaf-mould and sand, plunged in a moderate hot-bed. Seedlings may produce good or bad varieties; some sorts are known to be considerably hardier than others, and by raising a number of seedlings from different kinds, there is a probability that among them some will be found better suited to this climate than any hitherto imported from warm parts of the world.

Layers take root very readily. In some cases this mode may be employed for obtaining fruiting plants in a shorter period than they can be by any other means. In a forcing-house at Versailles we observed, in March 1847, plants in pots studded with an abundance of young fruit. These were obtained by layering, in the previous May, shoots or branches in a bearing state in small pots; the rooted layers were taken up in October, potted in 12-inch pots, and then taken into the house for forcing.

Cuttings should be taken from shoots that have not been injured by frost; or branches of the best ripened wood can be taken off before frosts set in, and buried in moist sand till early spring, when they can be made into cuttings, planted in pots, and plunged in a hot-bed. Care should be taken to rear them

with a single stem. They will strike in the natural soil in summer, but in a bottom-heat of 70° or 75° the process is rapid, and a well-rooted plant is soon obtained.

Good plants can also be reared from suckers, either in pots, with the assistance of bottom-heat, or in a warm border kept moist by watering; mulching will likewise prove beneficial.

Soil and Situation.—The fig-tree will grow in almost any soil. In the rich well-manured soil of gardens it grows, but too luxuriantly for the heat and light of our climate. We have known the roots of a fig extend nearly thirty feet in a kitchen garden, but the shoots were too luxuriant and soft for bringing fruit to maturity. Better wood is obtained where the fig is planted in a border not exceeding 6 feet wide, with a hard road or walk in front, into which the roots can scarcely penetrate. A chalk bottom suits the fig well, for such affords a moderate supply of moisture in dry weather, and in wet it permits superabundant moisture to percolate through it, so as not to remain stagnant about the roots. Where such soil does not naturally exist, the sub-soil ought to be well drained. A rich friable loam is to be preferred, and if calcareous so much the better.

The situation should be warm, yet a free circulation of air is essential, and the foliage must be well exposed to light, otherwise it is apt to become yellow, and the fruit is then likely to drop off. A wall with a south, or nearly south, aspect is the best, and next to this, one that has a south-west exposure. Near the coast, in the southern parts of the kingdom, the tree will grow as a standard; and in parts of the kingdom inland, where the summers are warm, but the winters occasionally severe, figs may be planted as espaliers if walls cannot be afforded. In this way their branches can be trained so as to expose the foliage to light and air in summer, and in winter they can be more easily protected than standard trees.

M. De la Bretonnerie states, in *L'Ecole du Jardin Frutier*, that the sandy gravelly soil of Argenteuil, near Paris, suits the fig remarkably well; but the best are those which grow in old quarries, where their roots are free from stagnant water, and where they are sheltered from cold, and exposed to a very hot sun, which ripens perfectly the fruit. The water which collects in the ravines keeps them

constantly supplied with moisture. He says that he has always found that it succeeds well planted in a paved court, against a building with a south aspect. A fig-tree thus planted and left to grow at liberty will produce excellent figs, and in much greater quantity than in any other situation. The paving protects the roots from frost in winter, and drought in summer; and whatever may be the nature of the soil under the pavement into which the roots penetrate, the tree always thrives well. We have not had an opportunity of seeing the tree planted in the above manner; but we have no doubt that a trial of it would be attended with successful results, for the roots of a Royal Muscadine vine planted, near London, against a wall in a paved court, extended beneath the pavement, and the grapes were the finest we ever saw produced out of doors in this country; and circumstances so highly favourable to the vine would doubtless prove equally so to the fig.

Mode of Bearing.—It is necessary that this should be well understood, otherwise errors in pruning, and other points of management would most likely be committed.

The fig-tree is deciduous; it pushes late in spring, near London in the first, second, or third week in May, and continues growing till late in autumn, if not checked by frost. Whilst the young shoots proceed in growth, one, and sometimes two, fruit-buds are formed in the axils of the leaves, frequently in the axil of every leaf along the shoot in succession, from the base upwards. The earliest formed, those situated on the lower portion of the shoot, attain a considerable size, but very rarely attain perfection in this country, as they do in the Levant, and other parts where the climate is well adapted for the growth of the tree. Here they remain, however, on the shoots after the leaves drop in autumn, but their growth is then of course arrested; they begin to shrivel, and in the following spring wither, even although they may have been protected from frost in winter. Such is the fate of all young fruit that may have acquired any considerable degree of development on shoots of the current season. But towards the extremities of these shoots fruit-buds continue to be formed, which are in a small compact form when the season of growth is over, and these embryo fruit-buds, which are about the size of a marrow pea, retain their vitality through the winter, grow and ripen in the

course of the following summer. The fruits which in this climate attain maturity in the open air, being principally derived from the extremities of the shoots, the latter, it is evident, must be saved in pruning, and protected from the injurious effects of frost. In many cases the shoots grow very luxuriantly, their wood being soft and spongy, more especially that towards the extremities, where, as just stated, fruit-buds that remain dormant yet retain their vitality through the winter are situated. Their position on the youngest and softest part of the shoots is not the most favourable for the fruit attaining the greatest perfection, and it would therefore be desirable if by any means fruit-buds could be induced to form lower on the shoot. The only chance of effecting this is to rub off the figs that naturally form there, so that the sap that would otherwise flow into them may excite latent fruit-buds to push late enough in the season for standing the winter. The time when this should be done cannot be precisely stated, for it will of course depend on the locality—on the season, whether early or late, and on the nature of the variety on which the operation is performed. In the *Journal of the Horticultural Society*, vol. iii., p. 230, there is an account of a brown Turkey fig, trained against a wall with a south-west aspect, at Pitmaston, near Worcester, and some of the observations made respecting that tree, bearing upon the point in question, may here be introduced:—"The fruit was not merely at the extremities of the shoots, as is usually the case out of doors, but at intervals all along from their bases upwards. For example, a shoot 40 inches in length had eight fruits, of which four were situated respectively at 3, 6, 15, and 21 inches from its base; the others were borne at somewhat variable intervals on the upper portion. The young figs which formed on the shoots of last summer's growth, now the bearing shoots, were all rubbed off in the previous August. When the blossoms of apples, pears, strawberries, raspberries, &c., are cut off, a second blossoming is induced. The fig manifests the same disposition on its being prevented from nourishing its first-formed fruits. Deprived of its first it makes an effort to produce a second progeny. The particular period of the season when the shoots ought to be stripped of their first-formed fruits must be determined by experience, for it is connected with variable cir-

cumstances of soil, climate, and situation. As above stated, the operation was performed in August on the tree at Pitmaston; and the results justify the conclusion, that it was done at the proper time as regards the condition of that tree."

The Rev. George Swayne states, that not a single fig, that can be seen to be a fig, fairly protruded from the bud in autumn, will ever become a perfect fruit in the following season. Not one of this description, therefore, should be left. His plan was to rub or break off with the finger and thumb all the figs produced on the same year's shoot, as soon as they can be distinguished by the naked eye, in order to give the tree sufficient time to exert its powers in the seasonable preparation of new embryo figs for the following year, in the room of those immature fruits of which it has been deprived. If this operation be performed in due time, it will not fail to prepare on one and often on both sides of almost every fig so displaced such embryos. Alluding to the figs on the young shoots, he says, they usually begin to show themselves at the beginning of August, from which time the trees should be examined once a week in order to displace them, and this examination must be repeated as long as young fruits make their appearance (*Hort. Trans.*, vol. iv., p. 430). These remarks should, of course, be understood to apply to those first-formed fruits on the lower part of the shoots, and not to such fruit buds as are likely to remain in the bud state during the winter, resuming their growth with the fresh flow of sap in spring, and maturing their fruit in the course of the summer.

Pruning and Training.—The fig-tree, grown as a standard, requires but little pruning; it has often been said the less the better, and this is true, unless the operation be done very judiciously. If the roots are in rich soil, and the knife be freely applied to the branches, the consequence will be that from the base of each strong shoot cut back others equally strong, or even stronger, will proceed. If the shoots be cut so closely as not to leave an eye, the accumulated sap will in other parts of the tree stimulate buds to push shoots too vigorous for bearing.

It has been explained that the fig-tree bears on the shoots of the current year fruits that attain maturity in favourable climates, with the exception of some of the latest formed, which even in those climates do not

ripen till the following season. But with us these exceptions become the rule, for our principal crop is derived from near the extremities of the shoots of the previous season's growth, except where artificial means are successfully employed to start embryo shoots near the base of the shoot. But whether the fruit is matured in the first or second season it originates on the young shoots, and therefore of such it is evident we must endeavour to keep up a regular supply. This should be done without adopting the general recommendation of cutting out the oldest branches. A mode of training by which this can be avoided, and at the same time a constant succession of young shoots can be maintained, deserves to be noticed, more especially as it is very simple, yet strictly systematic. It was suggested by a writer in the *Gardeners' Chronicle*, 1848, p. 621, and is as follows:—From a single upright stem branches are trained at a foot apart, but they are not on both sides in the same horizontal line; one branch is trained from the central stem, say to the left; at 6 inches higher another is trained to the right, the next to the left, and so on, the branches on one side proceeding from opposite the middle of the intervals between the branches of those on the other. In autumn every alternate shoot is cut back to one eye; the others are left at full length to bear fruit in the following summer, after which they are each cut back in autumn to one eye. The shoots proceeding from the single eyes, to which the shoots or branches are cut back, are trained at full length. They will form fruit-buds in the first season, and in the second year of their growth will bear fruit. They are then in their turn cut back to one eye.

By this plan all the branches have the same horizontal direction, and can consequently be the more easily maintained of equal vigour. The extent occupied along the wall may be limited to 6 feet, yet the tree may ultimately be made to occupy that extent in width from the bottom to the top of even a high wall; and we may remark that the higher the wall, the greater will be the heat and the better will the figs succeed. It is necessary, however, to observe that by adopting the above mode the quantity of young wood will be great in proportion to that of the old, and when that is the case the shoots are not so firm and short-jointed, and consequently not so well adapted for bearing. If succulent,

over-luxuriant shoots are produced, the roots should be confined, and the soil should not be enriched.

We shall now proceed to detail a mode of pruning and training the fig-tree against a wall or espalier, according to which a number of branches are retained to bear the shoots on which the fruit is produced; the former are intended to be permanent, the latter temporary.

Presuming that the tree is planted against a wall, let it be cut back to within 15 inches of the ground, and trained with a single stem to the height of a foot. Immediately above this let two shoots be trained, one to the right and another to the left, as directed in training the peach-tree; and from these principal branches two other sub-divisions should be encouraged. But these must be trained widely apart, in order to admit of successional bearing shoots being trained between them. These principal branches should be at a greater or less distance according to the size of the foliage; it depends, therefore, on the variety as well as the richness of the soil. In general, 15 inches will not be too wide. Along these branches, at distances of about 8 inches, shoots for bearing ought to be encouraged, and it is most desirable that all of them should be as nearly as possible of equal vigour. A similar equality should be maintained between the respective leading branches. It is a bad plan to allow one or more shoots to grow stronger than the generality throughout the season, and then to cut them back. Instead of doing so they ought to be checked by pinching, as soon as they exhibit symptoms of over-luxuriance. Look at the amount of foliage in connection with the respective branches, compare that on the different shoots springing from the same branch, then apply means to equalize them. By attending to these directions an equal distribution of the sap will be insured, and the result will be a disposition to produce fruit which will not be so liable to drop off as when irregularity of growth is permitted, for then the flow of sap must also be irregular, and when this is the case the fruit is never secure.

The bearing shoots, those produced along the leading branches, should be trained at full length. In autumn every alternate one should be cut back to one eye; at the same time those not cut back must be trained at full length. In the following summer the latter should

bear and ripen fruit, and then be cut back in autumn to one eye, and shoots from the bases of those cut back the previous autumn should be trained for succession. In this way every leading branch will be furnished with shoots of the current year for succession, alternately, with shoots or branches of the former year for bearing.

According to the vigour of the tree the shoots may proceed from the leading branches, at greater or less distances apart. When there is a considerable quantity of firm wood deposited in the leading branches, the shoots will also be firmer and shorter, and a greater number may be trained between the leading branches without being overcrowded. Young shoots will push from the extremities of those branches on which the fruit is being matured. But these branches are destined to be cut back at the end of the season; therefore young shoots from their extremities need not be encouraged. On the contrary, it is advisable to check them by pinching their terminal bud when they have made four leaves. These will prove beneficial to the fruit by drawing sap along the branch; but if the terminal shoot be allowed to grow unchecked, it is apt to rob the fruit, especially if it should start into vigorous growth; for it is well known that fruits situated in the vicinity of vigorous shoots are apt to drop. Instead of pruning back the branches at once to one eye, they may be only partially shortened as soon in autumn as it is found this can be done without much loss of sap from the wounds; after some weeks they may be shortened nearly to one eye, and finally cut more closely to it in spring.

Protection.—Where the climate is rendered comparatively temperate by the sea-breeze, fig-trees in ordinary winters require no protection. Along the coast of Sussex it is never thought of. But in most parts of the kingdom it is necessary, otherwise trees that have formed a large proportion of old wood, and which consequently produce firm bearing wood, would be occasionally killed to the ground, and in that case a number of years must elapse before they can attain a bearing state. The covering should be thin in mild winters, but provision should be made for readily increasing it if the weather become severe.

Various modes of protection have been adopted. At Argenteuil, near Paris, where the fig is extensively cultivated in the open

ground, and where the winters are often more continuously severe than they are in Britain, the extremities at least of the branches are laid in the soil, which is of a sandy nature, and the parts not interred are covered with straw or litter. The same plan has been successfully tried in this country; but it is not to be recommended where the soil is not of a sandy nature, neither is it practicable where the branches proceeding from a single stem become strong. Sometimes the branches of standards are tied together and then thatched with straw, forming a cone, or they may be tied in several bundles, and each covered separately; but a backing of thatched hurdles on the north side, and a slighter covering of straw mats on the south would be preferable.

With regard to the protection of fig-trees trained against walls, spruce branches have been found to answer the purpose exceedingly well, owing to their leaves dropping off gradually when the weather becomes milder and the trees require less protection and more light and air, in spring. If spruce branches cannot be had, other coverings should be contrived, so that they may also be gradually diminished in spring; for it is a bad plan to keep the whole of the winter covering on figs till danger of frost is over, and then uncover them entirely, and at once. Straw, or better, straw mats, dried fern, reeds, woollen nets, or canvas may be employed. The straw mats can be made thin, and applied two-fold in winter, and reduced to one in spring. Against a south wall a boarded covering, or thatched hurdles, projecting 4 feet from below the coping, with a slope to throw off the wet, will generally prove a sufficient protection unless the weather be very severe, in which case the trees should be matted in front, and litter laid round the base of the stem. The main stem should be well protected, for when it is killed all other parts above ground must give way; but if the stem is uninjured, other parts that may be affected can soon be reproduced. By employing the preceding means of protection, or others equally well adapted, one good crop of figs may be annually obtained.

Forcing.—It is a question whether as much produce cannot be obtained from a wall, with the assistance of glass and fire heat, as is afforded by double the extent of open wall.

A wall 60 feet in length may cost, say £30, but if half that extent covered with glass will

yield as much produce, then £15 may be saved in wall-building, and applied to lessen the expense of glazing; and taking all things into consideration, we believe that a glazed structure would be the cheapest. The supply of fruit from such would be less precarious than from the open wall, and it can be had from an early till a late period of the season. Convinced of these advantages, Mr. Henry Bailey had a house erected, at Nuneham, over a large fig-tree on a south wall. The tree was root-pruned in September, and fire was lighted on the 1st of February, a humid atmosphere, with a temperature of 55° at night, and from 65° to 75° during the day, being maintained. The roots were supplied with tepid water, and copious syringings were given till the fruit attained the size of a walnut fit for pickling, when they were discontinued. "So tender," Mr. Bailey remarks, "is the skin, and such is the disposition of the ripe figs to mouldiness, that every vestige of moisture must be avoided during the ripening period." The tree in question ripened its first fruit on the 25th of April, continued bearing till August, and had then many dozens to ripen, which assisted by fire-heat would afford a supply till November.

The fig requires a somewhat higher temperature to bring it into leaf than the vine. In the open ground its leaves appear near London in the first week of May, when the maximum temperature in the shade averages 62°, and the minimum 42°, the mean being 52°; but at Naples, according to Professor Gasparini, the trees begin to shoot in March. It thus appears that in the south of Europe, where two crops of fruit are ripened, the season of growth commences two months earlier than with us, and it continues three months longer, as will be seen by the following table, which exhibits the mean monthly temperature of Naples, Messina, and the neighbourhood of London, from the time that vegetation commences:—

	Naples.	Messina.	London.
February, . . .	47.59	54.21	...
March, . . .	51.15	56.66	...
April, . . .	56.68	60.58	...
May, . . .	64.85	67.21	53.44
June, . . .	70.77	73.87	60.25
July, . . .	76.10	78.46	63.05
August, . . .	76.26	79.09	62.01
September, . .	69.35	75.74	56.87
October, . . .	61.93	69.42	50.05
November, . .	53.11	62.67	...

From the above it will be observed how short is the period from the time that the mean

temperature reaches a certain point, and when vegetation is excited in the fig, till in autumn the declining temperature falls below that point. It is scarcely six months. In Italy the period extends to ten months, and in four of them the heat is of great intensity; at Messina, for instance, the hottest four months average 76° 74'; at London they average only 60° 55'. On referring to the articles on forcing the peach, plum, and cherry, it appears that the fig requires a much higher temperature to bring it into leaf than either of the above kinds of fruit. In forcing, therefore, this should be borne in mind. It may be commenced at 50° at night, and from 60° to 65° maximum in the day. Afterwards the temperature of Naples may be imitated, or even that of Messina, in clear weather. At night the thermometer in the house may fall 8° below the mean at the above places, and may even rise as much above them in the day, taking care, however, that plenty of air is admitted.

It would be desirable that the roots of the plants should be in a temperature corresponding, or nearly so, with that in which the tops are situated, as is the case in countries to which the fig is indigenous. At all events, every means at command should be employed to render the disparity as little as possible. In the growing season water so cold as to lower the temperature of the soil, or that of the pots, should not be used. If the trees are planted out in the border of a forcing-house, the soil can be heated by pipes, care being taken that it is invariably kept in a proper state as regards moisture; or it may be heated by fermenting materials.

In a temperature suitable for the fig the amount of evaporation from the leaves is very large; and whilst the young fruit is swelling this amount must be constantly supplied, otherwise the milky juices of the plant will become inspissated, so that they cannot circulate properly, and the fruit must then drop. Syringing the foliage and moistening the floor should be daily practised to keep down the red spider, until such time as the crop is beginning to ripen, and then a moderately dry atmosphere should be maintained, with plenty of air at all times when the state of the weather permits.

Forcing Trees in Pots.—Good crops can be obtained from trees in pots; and by successive introductions into heat, a supply of fruit from the formation near the extremities of the pre-

vious year's shoots can be obtained in succession for a considerable period, or until the second crop begins to ripen. Good turfy loam answers very well for potting, and manure water may be occasionally given, but not if the tree is growing well enough without it. The pots should be plunged in tan, or preferably in a bed of leaves, of the temperature of 65° or 70°. When a plant in the largest sized pot requires shifting, it may be turned out, the ball and roots reduced, and then repotted with fresh soil into the same pot.

THE GOOSEBERRY AND CURRANT.—These require about the same temperature in the early stage of their growth, and may accordingly be forwarded in the same house. The currant, both red and white, will, however, stand more heat than the gooseberry during the ripening period.

The plants should be reared with a single stem, clear of branches, to the height of three inches above the ground. They ought to be transplanted in rich soil early in autumn, and again next autumn. In the beginning of the following September, they should be potted in rich turfy loam. They will make fresh roots, and establish themselves in the pots before winter. The pots should be protected from frost. The plants ought to be brought into a temperature not exceeding 50° at first, with plenty of air, and if it fall as low as 40° at night, so much the better. If there be much sun-heat, there should be abundance of air, so that the foliage may be thick and robust. Let the temperature be gradually raised to 55° maximum, and it may be 45° minimum, then 60° maximum, and 50° minimum. As the season advances, the currant may be allowed quite as much heat as we have in warm seasons in June and July, or about 65° maximum; but this is too much for the gooseberry. It is better flavoured in a cooler climate. If, on account of other things that may be forcing in the same house, it is necessary to maintain a higher temperature than is suitable for the gooseberry, the latter must be shaded from strong sun. Manure-water should be given occasionally till the fruit begins to ripen, and it ought to be borne in mind that it is better to keep the plants healthy by a due attention to watering than to neglect them several times, and thus render them liable to a severe attack of red-spider; and then have to overcome it by much syringing.

THE MELON (*Cucumis Melo*, L. *Monecia* Mo-

nadclphia, L.; Cucurbitaceæ, D.C.; Cucurbitaceæ, Lind.) is an annual, climbing where its tendrils meet with support, trailing where this is not the case, and a native of the hot parts of Asia, and probably also of Africa. It is said to have been carried from Armenia to Rome by Lucullus; and according to M. Jaquin, the Cantaloup varieties were originally brought from the same region by some missionaries to Cantaluppi, a villa belonging to the Pope, and situated a few miles from Rome. Afterwards, they were introduced into France in 1495; from thence they passed into Spain, and from that country into England.

In Persia, melons are exceedingly plentiful, and their cultivation in the open air in the plains of Ispahan and at Bokhara, is considered to be unsurpassed. At Cabool, melons are grown in great abundance. The country, although in latitude 34° N., is covered with snow to a great depth in winter, but in summer the valleys become very hot, and in these the fruit acquires a high degree of perfection. Some officers in the unfortunate expedition to the above place, sent home seeds of different varieties of Cabool melons; when grown in this country they have proved exceedingly prolific, and some are very melting and sugary, but all are apt to degenerate. According to Downing, the climate of the middle and southern states of America is remarkably favourable to melons; consequently they are raised as field crops by market-gardeners, who sow the seeds in the open air early in May, and obtain ripe fruit in August. At Washington, the mean temperature towards the end of May is about 70°; that of June 75°; of July 78½°; and August 76½°. This temperature nearly corresponds with that which prevails over a great portion of the American States, and it is sufficient for the hardier sorts of melons; but where these succeed in America, it is found that the Persian and some other sorts require a higher temperature, with the protection of glass, till July, and occasionally afterwards during cold nights and stormy weather. Hence it appears that certain varieties of melons require a higher temperature than others.

The Rock and Cantaloup varieties—those which have been so long cultivated in Europe—will succeed with a bottom heat of 70°, or from that to 75°. They will do well with a bottom heat of 70° when the plants are in a very young state, gradually raising it to 80°, say at the rate of about a degree per week.

The bottom heat should never be allowed to decline, but commencing with the minimum it should progressively rise to the maximum. It certainly is not a correct imitation of nature to begin with a high temperature, and gradually finish with one comparatively low. The seeds, it is true, require a brisk heat for their vegetation; for in the case of those that naturally spring up in countries to which melons are indigenous, the surface of the ground is at that time much warmer than the soil lower down, where the roots soon afterwards penetrate, but as the heat of the season increases, the soil about the roots becomes warmer; or, in other words, the bottom heat gradually increases as the growth of the plant proceeds. With sun heat the atmospheric temperature may be allowed to rise to 85° when the plants are young, afterwards to between that and 90°, or even higher if the plants are well conditioned, and plenty of air be judiciously admitted. Although this is not higher than is frequently borne from sun heat by vegetation out of doors in summer, yet under artificial treatment, and after a period of dull, cloudy, wet weather, such as frequently occurs in our climate, the foliage of the melon is not adapted for bearing the full force of the sun's rays. It must, accordingly, be modified in the first instance by shading, which should be gradually diminished as the plants become more accustomed to the light. The same remark applies to the Persian varieties, but they may be allowed a bottom heat of 75°, gradually increasing to 80°; the top heat should range from 72° to 82° when the fruit is swelling, and at all times, as much sun heat may be allowed as the plants can well bear. With regard to moisture, a considerable amount of it is required. It should be borne in mind that the foliage of the melon evaporates much moisture when growing in the open air, and in that case the plants are healthy. When confined in pits or frames, and kept long in a close moist atmosphere, evaporation cannot proceed, and the plants become unhealthy. It is, therefore, necessary that a certain amount of evaporation should be encouraged, but to support this, moisture in a corresponding degree must be supplied to the roots. There are many plants that will grow luxuriantly whilst their roots have moisture; the supply of this may fail, and growth may be arrested for weeks, or even months, yet it will be resumed, and the plants will again acquire their former healthy

appearance when a fresh supply is afforded; but the melon is not one of these.

Varieties.—These may be arranged under two heads—*Scarlet-fleshed* and *Green-fleshed*. The varieties of both are exceedingly numerous, as it may easily be supposed must be the case in a tribe of plants propagated by seeds, and readily hybridized both naturally and artificially; and new ones are being continually produced, so that in a few years most of the older sorts become supplanted by others of superior quality.

SCARLET FLESHED.

1. **BLACK ROCK.**—From 8 to 12 lbs., oblate; surface earbuneled, dark green, blotched with black; flesh of a fine reddish orange, tolerably rich, if not allowed to become too ripe before it is cut. A good bearer, and much grown for the market, but not early.

2. **CANTALOU NOIR DES CARMES.**—About 4 lbs., round, obtusely ribbed, blackish green; flesh red, melting, rich, and excellent. An early variety, of vigorous growth, hardier than many, and therefore very useful when delicate varieties fail.

3. **DUTCH ROCK.**—From 5 to 8 lbs., oblate, earbuneled, yellow; flesh orange, firm, sweet, and tolerably good. An abundant bearer, and rather early. It is chiefly grown for market.

4. **WINDSOR SCARLET-FLESHED.**—From 3 to 5 lbs., roundish, green; flesh deep salmon, rich, and sugary. This sort has been extensively cultivated, and has given rise to many new varieties of similar character. It is one of the best of the scarlet fleshed melons, though not so early as some.

GREEN-FLESHED.

5. **BEECHWOOD.**—From 2 to 3 lbs., oval, netted, greenish-yellow; flesh greenish-white, melting, rich, and sugary. An excellent variety, tolerably early. Originally from Persia.

6. **BROMHAM HALL.**—From 2½ to 4 lbs., roundish, flattened at the ends, very slightly ribbed, somewhat netted, grayish-green, tinged with yellow next the sun; flesh green, very rich, and sugary. Early, and a good bearer.

The *Victory of Bath*, an excellent sort, may be considered a sub-variety of this.

7. **EGYPTIAN GREEN-FLESHED.**—From 2 to 3 lbs., roundish, a little flattened at the ends, slightly netted, grayish, or silvery-green; flesh green, juicy, exceedingly rich, and sugary. This excellent variety has long been cultivated, and has given rise to many sub-varieties, although it is less apt to vary and degenerate than many other sorts. Some proved seeds of this kind should always be kept; for they may come in useful when new varieties begin to lose their excellence.

8. **GREEN HOUSAINEE.**—A Persian variety. From 3 to 4 lbs., oval, or ovate, netted, pale green, with a yellow tinge next the sun; flesh white, tender, sweet, and rich. An abundant bearer, hardier than many other Persian varieties, and ripening late.

9. **KEISING.**—A Persian variety. From 4 to 5 lbs., ovate, netted, pale lemon; flesh nearly white, of very delicate texture, and exceedingly juicy, sweet, and rich.

10. **LARGE GERMEK.**—Also Persian.—From 5 to 7 lbs., oblate, closely netted, and having a circular sear round

the centre of the crown, sea-green; flesh green, juicy, rich, and sugary. An early variety, and a very abundant bearer.

11. **PINE APPLE MELON**—syn. American Green-fleshed Pine Apple Melon, Melon Ananas à chair verte.—Very small, from 1 to 2 lbs. weight, round, ribbed, grayish-green; flesh green, exceedingly rich and sugary. An early and most productive variety, highly deserving of cultivation. Under one light, more fruits of this sort can be matured than of any other.

12. **SWEET MELON OF ISPAHAN**.—From 5 to 6 lbs., ovate, smooth, yellow; flesh white, melting, sugary, and very delicious. A rather late variety; by some esteemed the best of the Persian melons.

13. **TRENTHAM HYBRID**.—Weight 2 lbs., oval, greenish-yellow; flesh green, tender, melting and very rich. An early variety of great excellence.

Soil.—Good rich turfy loam answers well; if marly, so much the better. Some use the turf after being stacked up and dried, others when it is half decayed; and Mr. Mills recommends about 3 inches thick of the top of an old pasture to be chopped into pieces the size of an egg and used immediately. A strong loam, rendered compact on the surface, has been successfully employed for dung-beds, but it must be recollected that on these the roots of the melon penetrate into the mass of decaying materials, of which the bed is composed, and thence derive nourishment, whilst the loam rendered compact on the surface tends to prevent the escape of moisture from the bed. The top soil of rich alluvial pasture, such as has been overflowed in winter, has been found to answer well. It should, however, be of a friable and not of a clammy adhesive nature. A little well rotted manure may be mixed with the soil; but the latter ought not to be made very rich, otherwise a too luxuriant growth is induced. With turfy loam, Mr. Fleming mixes a little burnt marl. In Persia, and other parts of the East, pigeons' dung has been employed for the growth of melons from time immemorial, and it may be advantageously given in moderate quantity. The best mode of using it, is to make it into a compost with loam, in the proportion of six parts of the latter to one of pigeons' dung. This, after having been frequently turned, should be well mixed with the soil intended for the bed, at the rate of one barrow-load for each light. The dung of poultry may be used in a similar manner. For beds composed of materials, such as dung and leaves, into which the roots of the plants can strike and find nourishment, about 9 inches deep of soil above a layer of turf 3 inches thick will be sufficient. Where the roots have no source of supply but

the soil, this should have a depth of from 18 inches to 2 feet.

The means of supplying the necessary amount of artificial heat, require next to be taken into consideration. Formerly the heat, both top and bottom, was obtained by means of fermenting materials, and in many cases it still is; in others, it is wholly derived from hot water pipes; and in some, a combination of both these modes is employed, bottom heat being supplied by dung, tan, leaves, &c., whilst the air of the pit is heated by hot water.

Fermenting materials, as compared with hot water, have advantages and disadvantages for melon-growing. When well prepared, so as to be moist whilst fermentation is going on, the dung-bed affords a steady supply of moisture to the roots. This is of great importance, especially in a dry season. Some old gardeners never watered their melon-plants after they were established, or, in other words, none was necessary after the roots struck into the moist dung of the bed. On the other hand, there is much more difficulty in regulating the heat from fermenting materials than that supplied by well arranged hot-water pipes. As regards the materials and their preparation for hotbeds, the directions already given in the case of the cucumber, are equally applicable in that of the melon. The beds for the latter should, however, be 9 inches or a foot higher than those for cucumbers, and they should, if possible, be composed of materials that will maintain the heat for a longer period, such, for example, as a mixture of dung and leaves. The following are approximate data with regard to the amount of heat produced by the fermentation of various substances, as stated by M. Jaquin (*Monographie complète du Melon*):—

Sheep's dung lasts four months, giving a heat of 141° to 158°; dung of the horse, mule, or ass, six months, affording a temperature of 122° to 140°; dung of horned cattle, eight months, producing a heat of 95° to 113°; but if it is mixed with the dung of pigeons or poultry, a higher temperature may be obtained. Tan lasts six months, and dead leaves one year, giving in each case a heat of 95° to 104°.

The above temperatures will not, of course, be maintained throughout the whole of the period respectively mentioned for each substance. Linings will therefore be necessary before the heat falls below the point necessary for the plants being forced. It appears that whilst horse dung affords, with the exception

of that of sheep, the strongest heat, though of the shortest duration, leaves, on the contrary, produce a comparatively mild heat, but of much longer duration. A mixture of the two is therefore advisable, in order that the short but too violent heat of the stable dung may be corrected by that resulting from the milder but more lasting fermentation of the leaves.

Mr. Fleming, of Trentham, well known as an excellent cultivator of the melon, recommends the use of faggots in forming the bed—the latter to be marked off a foot longer and wider than the frame; and on the base so marked out, faggots are built to the height of 2 feet, and upon these other faggots, 18 inches in diameter, are laid lengthwise along the front, back, and ends, so that the edges of the frame may rest upon them. A cavity is thus formed in the interior, which is filled up with fermented dung and leaves. Doubtless this mode affords a great command of bottom heat, and, at the same time, a great saving of labour and materials for linings is effected; for when a dung-bed becomes compact, the heat from linings cannot readily pass to the centre; before it can do so, it must be stronger than would be necessary, when there is such ready access as that afforded by the faggots.

In making up the bed, some of the shortest of the dung should be reserved for the top layer, and after this is put on, about 3 inches thick of the melon soil may be laid over it. The whole surface of the bed should then be forked over, mixing well the short dung and soil. The reason for doing this is, that the roots of the plants, after having extended through the soil, on still proceeding downwards, may not have to pass at once from soil only into the substance of the bed where there is no soil; for a change so sudden must affect the regularity of growth in the plant.

Sowing.—Melons, like cucumbers, can be grown to a tolerable size without much sun-heat. In order to be fit for use, the cucumber requires only to be grown—the more green it is the better; but the melon must undergo the ripening process, and this cannot be carried to perfection without the agency of the sun's rays. In the absence of these, no amount of artificial heat will effect the conversion of the crude juices of the fruit into saccharine matter. In the generality of seasons, May is the earliest period that well-flavoured melons can be expected, although some have occasionally been produced in April. Such very early

fruit, however, can be obtained at least expense from plants in boxes or pots, in vineries or pine-stoves. For hotbed culture, we think the middle of January is early enough for the first sowing; but in some cases it may be advisable to sow previously in order to try seeds of doubtful quality. To sowings made at the above period accidents are likely to occur; light is then deficient, and in severe stormy weather sufficient air can scarcely be admitted; sowings should therefore be repeated at short intervals. About four months is considered the average time which elapses between sowing and ripening; but this period depends of course on such variable circumstances that it cannot be exactly stated. In summer it may be reduced to three months with early varieties. The seeds may be sown in a mixture of fine loam and a little leaf-mould in 3-inch pots, one seed in each pot. We are not aware of any good reason for raising more than one plant in a pot; by raising three in each the same number of plants could, it is true, be raised in one-third of the space in the seed-frame; but when we consider that at least sixteen 3-inch pots can be placed in a foot square, and that all the plants necessary to be raised for a three-light frame, allowing for accidents and choice, need not occupy a greater area of frame than a foot square, there can be no great objection as regards the additional room which plants raised singly in pots would require. The seeds should be covered with fine light soil to the depth of nearly half an inch, pressing its surface evenly. The pots should then be plunged in a heat of 70° or 80°. Light is not necessary; and the frame, if not too hot, may be kept almost close. As soon as the plants make their appearance, as much light may be admitted as circumstances will permit, in order that they may not be drawn up tall and weak, and the foliage should be kept about 8 inches from the glass. Air ought to be admitted through gauze or some such screen. As the stem grows up, a little fresh soil should be added; and when the roots have nearly filled the pot, but before they in the least entangle each other, the plants ought to be planted out in the bed, if this is in a proper condition to receive them; but if not, they must be shifted into 4-inch pots.

When the bed is made up, the soil should be introduced, in order that it may acquire the proper temperature. Some good cultivators turf the surface of the bed all over previous to

putting in the soil; others, only such portions of it as the hills for the plants are formed upon. About $2\frac{1}{2}$ feet wide, from end to end of the frame, and rather nearer the back than the front, may be turfed over, laying the green side downwards. A portion of the soil may then be disposed lengthwise in one or two ridges raised thin, and nearly as high as the glass, in order that a greater surface may be presented to the heat of the air of the frame. The sashes should be kept close except occasionally a little opening to permit the escape of rank steam. The heat may be increased by covering at night and by confining the heat from the sun's rays, when there is sunshine through the day, till the soil is warmed to 70° . Before planting, the soil should be collected so as to form one ridge rather nearer the back than the front of the bed.

Planting.—The usual mode of planting is to form a mound or hill of soil under each light, and to plant two or three plants near each other on the same hill. Good cultivators do not even plant cabbages close together; and we think that, like the generality of plants, melons would thrive all the better if placed as far asunder as circumstances will permit. We have therefore recommended the soil to be disposed along the bed, in the form of a ridge, in which the plants may be placed, at equal distances, say about 16 inches apart, or a little more or less, so as to admit of three plants being introduced under each sash. In some cases two plants may be inserted about a foot from the back of the frame, and trained downwards; another being planted about a foot from the front, and trained upwards between the other two.

The directions for the management of the cucumber as regards shading, watering, &c., will also apply to the melon for some time after transplanting. Whilst growing, the roots must always have plenty of moisture, and the leaves should be moistened once a day, either by syringing or by vapour, but their surface should be every day longer dry than moist.

Pruning and Training.—These are variously performed. Some stop or pinch off the extremities of the stem and branches at an earlier stage than others. It is sometimes necessary to allow the stem to proceed without stopping till it reach a trellis, where its ramifications may be trained. If laterals are produced, they should in this case be stopped so that one leaf may remain in order to strengthen

the stem, but no fruit should be permitted to set except on the shoots that branch out above the trellis. When large fruit is desired, or a large crop of small-sized melons, the plants should not be allowed to bear fruit till they have acquired considerable strength; therefore, till this is the case, the blossoms, both male and female, ought to be picked off. When the object is to have fruit as early as possible, the first blossoms that set their fruit must of course be taken advantage of, although when the plants are allowed to bear in a very young state, and containing but little organizable matter, they cannot produce such heavy crops as plants that are better established.

When the plants have to be trained on or near the surface of the beds, their tops should be pinched off above the second rough leaf, or rather the growing point ought to be nipped out before a third leaf is developed. It may here be observed, that this operation should not be performed just at the time when the plants are transplanted; it should either be done as long before planting as will allow the buds to break, or otherwise, not till after the plants have taken fresh root. The primitive stem will by the above operation be divided into two branches, one from the axil of each of the first two rough leaves. These two branches should be trained one towards the front and the other towards the back of the frame, and when they nearly reach these, the extremities should be pinched off; bearing laterals will be the result.

According to the *Bon Jardinier*, some excellent cultivators, more especially MM. François and Decouflé, have adopted a very simple mode of pruning, and with the best results. By pinching the young stem above the second leaf two branches are obtained. These are trained till each of them has formed at least six leaves, and then they are finally stopped by pinching off the extremities above the fifth, sixth, or even the seventh eye. All the lateral branches which break out in consequence of this pruning are allowed to grow freely. The plants thus treated bear as soon as those that are subjected to repeated mutilations, and the fruit is better nourished. When several young fruits have set, the shoots are pinched to one eye above the fruit selected as the most eligible to be retained; and, with the exception of that fruit, all the others which have set on the same branch are removed, as well as all that may subsequently form on it.

The plants will, in the course of the season, produce many more leaves and shoots than the limited space of the frame can well contain. There should be as many leaves as can be well exposed to light in the frame, and no more; therefore the production of young shoots ought to be carefully watched. When they push, their future extension and development of foliage must be taken into consideration, and the confusion which is likely to ensue be prevented by pinching off the shoots which are likely to become entangled when in a young state, instead of cutting away large portions at a later period. The more carefully the shoots are watched, and the more frequently they are regulated, the less will be the quantity of foliage necessary to be removed; and when this is the case the flow of sap cannot be much deranged, and a steady healthy growth will result.

Setting the Fruit.—The melon is dioecious, that is, it bears male and female flowers on the same plant; the former are essential for the fertilization of the latter, therefore a sufficient portion of them should be retained for that purpose. The male flower has three stamens, united by their anthers; but the filaments are distinct, and the part between the stalk and base of the corolla is slender and cylindrical. The female flower has a short style surmounted by three large bi-lobed stigmas, and the ovary is of an ovate form. In the male flower may be seen an abortive style in the midst of the stamens, and in the female flower, on the contrary, three imperfect stamens surround the base of the style.

When the weather is fine, and plenty of air can be given, the female blossoms usually become fertilized without artificial means being resorted to, but the process of *setting* the fruit, that is, fertilizing the blossoms, is generally thought necessary. This operation should be performed when both male and female flowers are fully expanded, and simply consists in taking some of the pollen, when it can be readily dusted from the anthers, and applying it by means of a camel hair pencil to the stigma; or a male blossom may be stripped of its corolla, and inverted in the female one.

When the young fruit is as large as an egg it should be placed on a piece of tile, and if shaded by a leaf let it continue so till the skin get firm; then it may be partially exposed, and when nearly full grown it may be raised so that the sun's rays may act upon it

as much as possible. Before the process of ripening commences the roots should have a good store of moisture, in order that none may be required from that time until the fruit is cut. During the interval the surface of the soil should be kept perfectly dry.

PEACH AND NECTARINE—With the exception of the vine no kind of fruit trees have been so generally forced in this country as the peach and nectarine. In the northern parts of the kingdom the fruit cannot be brought to full perfection on the open wall, but under glass, with more or less artificial heat, according to the climate and period of the season, fruit both large and excellent can be obtained, even in the most northern parts of the island. The tree requires a good soil, maintained in a proper state as regards moisture, abundance of light, that of the solar rays as direct as circumstances will permit, and a full command of heat sufficient for the growth of the trees and maturation of the fruit, even when the house is not closely shut up. A free circulation of air is essential for dispelling the moisture, which would otherwise lodge too long upon the foliage, or upon the blossoms and the fruit; for although the foliage must be washed, and the air of the compartment rendered moist at times, yet a moist stagnant atmosphere is injurious.

The border in which the trees are intended to be planted should be well drained, and care must be taken that by no possibility the roots can come in contact with water percolating through the substratum, or stagnant there. If a test hole were dug to the depth of 3 or 4 feet from the surface, and if in this water should stand for some weeks, at any period of the season, then means must be adopted to prevent the roots from ever going down so far. Draining is the best, provided there be enough of fall; if not, concrete or paving ought to be resorted to, if the expense can be afforded. If the bottom of the whole border cannot be concreted or paved, a portion may be done below, and to some distance from the place where the tree is planted, to prevent at all events tap-roots from forming; and if this be done, by good management the horizontal roots can always be enticed near the surface. In the case of bad subsoils, it is a good plan to build peach and other forcing houses on a terrace. The bottom having been put in a satisfactory condition, the soil may be laid on. The depth of this should not be less than 18

inches; we would recommend $2\frac{1}{2}$ feet, for a mass of this thickness will retain a more steady supply of moisture than a shallow border.

The soil ought to consist of good mellow turfy loam, which is substantial but not of a binding nature. If the loam is rich, manure will not be required in the first instance, except that it may be mixed with a little compost of loam and dung, made up a year previous, and well incorporated by occasional turning. According to the richness of the soil procurable for the border more or less compost should be used. If the soil is rather strong and adhesive, leaves or leaf-mould will prove beneficial, and some $\frac{1}{2}$ -inch bone manure will afford a supply of nourishment even after the trees come into bearing, when of course they require it more than at first. For very early forcing the border should be made so that the roots will be inside, and consequently not be liable to be chilled by cold rains or melted snow. The choice of trees partly depends on the position which they are intended to occupy in the structure. The best mode is to plant dwarfs in front, and train on wires from 12 to 15 inches below the glass, as is done in the royal gardens at Frogmore. In order that forced peaches and nectarines may be well-flavoured they must not be grown far from the glass. Some train dwarfs planted in front of the house on trellises, curved so as not to intercept the sun's rays from the trees which are trained against the back wall. We have known trees which were trained on a trellis at a considerable distance from the glass; but they did not yield good crops till their branches were raised and trained near the glass; excellent crops were then obtained. It is not the greatest quantity of shoots and foliage that can possibly be grown under a certain extent of glass that should be the aim, but the greatest amount that the sun can shine upon with the fullest effect. Now, let us suppose that the roof of a forcing house is composed of one entire sheet of bright glass, and that between this and the floor a medium of ground glass is to be interposed where it will transmit the greatest quantity of light. To do this, it must be placed where the light or the sun's rays can act through the sheet of glass with the greatest intensity. It must, then, be placed so as to form a plane near to and parallel to the plane of bright glass. The medium of ground glass might be waved to curve away from the glass roof like the circular front trellises which some

recommend for the peach; and having reeched considerably, it might then curve upwards to the top of the back wall. This curving would require a much greater surface of ground glass than a plane running parallel to the roof; but the light below would be considerably less in the former than in the latter case, because the light after passing through the bright medium would act with diminished intensity on the portion of ground glass situated at a distance from it. So, if curved trellis work were constructed there would be a greater surface for training, but the amount of the action of the light on the foliage would on the whole be diminished. If we take a lens and hold it near the glass of a forcing house when the sun is shining, touch-paper will be readily ignited; but it will not be so if the lens is held at a distance from the glass. From what has been stated it is evident that in order to receive the fullest amount of light that can possibly be transmitted, the trees must be trained in the direction of a plane, running parallel to the glass, and as near to it as circumstances will permit. A distance of from 12 to 15 inches, as already stated, answers very well; farther would prove disadvantageous so far as light is concerned, a less distance would indeed be preferable in that respect; but, on the other hand, vegetation would be injuriously affected in severe weather if brought into closer proximity to the then cold glass.

The trees may be planted young, or they may be trained for several years, but in this case they should be taken up and replanted every second year. Their training ought to be conducted with a view to the position they are intended to occupy. They should be treated as directed for fan training in respect to starting the branches. The length of the stem must depend on the height of the roof from the ground, at the place where the trees are to be planted. The stem should be cut over so as to subdivide 15 inches below the glass. The branches ought to be trained with an inclination equal to the angle of the roof. By attending to this a tree may be reared to a bearing state before it is introduced under glass. Mr. Errington, one of the most skilful gardeners in the country, selected the largest, cleanest, and best formed tree on the open wall, where it covered 480 square feet, removed it to a peach-house, of course with due care, and the tree ripened in the same year about eight dozen of very good

peaches. In the succeeding seven years it produced at least 2300 large and fine fruit. Specimens of the fruit we have frequently had the opportunity of seeing, and certainly they were remarkably fine. This is sufficient proof that trees of considerable size may be introduced into a peach-house. The best time for planting is after the leaves have fallen in autumn, but it may be done any time in November or December, but not later than January, unless in cases of necessity. Removal after the sap is in active flow is injurious.

The pruning of the tree should be conducted on the same principles as those explained for the peach-tree on the open wall. In summer care must be taken to maintain as far as possible an equal distribution of the sap, by checking over-luxuriant shoots in good time, and encouraging those that are weak, by the means pointed out in the articles on pruning and training.

Before commencing to force, the house, sashes, and glass should all be thoroughly cleaned. The stems and branches of the trees ought to be scrubbed with a brush and water, and then done over with a mixture of sulphur, a little soft-soap, and tobacco liquor.

The house may then be shut up, without fire-heat, unless the weather is severe, and in that case as much may be allowed as will keep up the temperature at night to 40°. It may be allowed to rise to 60° by sun-heat. Fire-heat must be very sparingly applied whilst the blossom buds are swelling, whilst the flowers are expanding, and until the fruit is set. At the period when the peach is in flower on the open wall, the nights are usually cold, but if not so severe as to freeze the blossoms, the fruit sets very well. Mr. Errington's tree, above mentioned, was sometimes exposed to a temperature of 34° at night, when the young fruit was as large as pease, without injury. There is less danger to be apprehended from a low temperature, provided it is not so low as freezing, during the blossoming period, than from a high one. The latter has often caused the total loss of a crop, the blossoms dropping prematurely after the house has been kept close, and too warm by fire-heat at night. It is not, however, absolutely necessary that the temperature should be so low as 34°, although that will not do harm, except in retarding the process. As time is an important object in forcing, it is desirable,

where fuel can be afforded, that as much heat be applied as can be done with perfect safety, both as regards the health of the tree, and the security of the crop. Although Mr. Errington states the low night temperature to which his tree was occasionally subjected, yet that judicious cultivator says that was through sheer necessity, and that in his anxiety to get fruit early he would have kept it probably to 50°, but, he adds, that he is convinced it would have been worse for the tree. We would therefore recommend, as a safe medium, 40° at night, or, at all events, not more than 45°, and if the latter be occasionally adopted, air must be admitted at the same time. Through the day the temperature may be allowed to rise by sun-heat to 60° or 65°, with plenty of air; but any sudden reflux of cold air causing a lowering of the thermometer should be avoided. Air must be given to prevent the temperature from rising excessively, but not so as to lower it after it has reached too high a point. Independent of sun-heat the range of temperature between the minimum at night and maximum by day may be 15°. For example, if at a certain stage of forcing the highest temperature by sun-heat ought not to exceed 75°, and should the thermometer in the peach-house reach that point in the early part of the day, air must be given to prevent it from rising higher, but not so as to lower it suddenly.

After the blossoms drop, the condition of the expanding foliage should be carefully watched. If it appear tender compared with that observed in a similar stage on peach-trees on the open wall, less heat and more air must be given, till by a slower growth the proper firmness of texture is produced.

When the young fruit is the size of small marbles the heat may be gradually increased to 50° at night, and 65° by day, or 70° by sun-heat. After the fruit is stoned the temperature may be raised to 55° or 60° minimum, 70° maximum, and 75° or 80° by sun-heat. When the fruit is half grown a high temperature can be safely allowed, provided the trees are duly supplied with moisture, and are in a vigorous healthy condition, which will be promoted by frequently syringing the foliage, and maintaining a proper degree of moisture in the air of the house. Syringing should be practised from the commencement of forcing till the blossoms are beginning to open. The air of the house must not at that time be too dry. At night it should be rather moist, otherwise

the trees will not thrive, and the red-spider will be apt to commence its attacks on the foliage as soon as it begins to expand. The paths and soil should therefore be sprinkled occasionally. After the fruit is set, the trees ought to be well syringed to clear off the faded blossoms. The foliage at this time is scanty, yet on such as it is depends the flow of sap, which must be seriously deranged if the young leaves are in a great measure destroyed by red-spider. If there are any signs of this pest the house should be syringed twice a day, in the morning and afternoon. When the fruit begins to ripen syringing must be discontinued till the crop is gathered, after which the syringe should be occasionally used, for until the leaves have fulfilled their purpose, and have naturally begun to decay, it is advantageous to keep them in good health.

In order that the fruit may acquire good colour and flavour, it should be exposed to light and air when ripening. It will bear the direct rays of the sun, if they should even be equal to 100°. Leaves that shade the fruit, not only when ripening, but during its growth from the time of stoning, should be gently turned aside.

Early forcing is trying to the constitution of the trees, and rather than run the risk of injuring permanent trees, it is better, when fruit is wanted very early, to obtain it from plants in pots if there is a pine-stove or early vinery at work, or a pit might be built on purpose. Mr. Hutchinson, of Eatington Park, ripened peaches in pots as early as the first week in April. The trees should first be potted in autumn, in 12 or 13-inch pots, and next autumn they ought to be shifted into a larger size. They should be introduced into heat in spring, so as to ripen the wood early; and as soon as this is the case, in the following autumn they may be shifted into 18-inch pots, filled with rich friable loam, and then introduced in November into gentle heat. The temperature should be kept comparatively low, especially at night, till the fruit is set, and then, as we have already remarked, the plants will bear an increase of temperature, even the heat of a pine stove, as Mr. Hutchinson has repeatedly proved. But when subjected to such high temperature, great care must be taken that the roots are supplied with a proportionate amount of moisture. The water employed should however be as warm as the air of the house, for on this, success will greatly

depend. If placed in a structure specially adapted for such forcing, the temperature after the fruit is stoned should be raised as high as the plants are seen to bear safely, and it ought to be allowed to fall at night as much as is found necessary to produce robust foliage of a firm texture.

PINE-APPLE (*Bromelia Ananas*, L.; *Ananassa sativa*, Lind.—Hexandria Monogynia, L.; Bromeliaceæ, Lind.)—The pine-apple is a native of the tropical parts of America, and from its growing in great abundance in the hot parts of Asia and Africa it has been supposed by some to be indigenous to these continents. Dr. Lindley, however, in treating of Bromeliaceæ affirms that all, without exception, are natives of the continent and islands of America.

Miller states, in his *Gardener's Dictionary*, ed. 1768, that pine-apples "have been long cultivated in the hottest islands of the West Indies, where they are in great plenty, and extraordinary goodness; but they have not been many years in the European gardens, so as to produce fruit. The first person who succeeded in this affair was M. Le Cour, of Leyden, in Holland, who, after a great many trials with little or no success, did at last hit upon a proper degree of heat and management so as to produce fruit equally good, though not so large, as those which are produced in the West Indies." Miller further adds, that it was by M. Le Cour that the English gardens were first supplied with plants. If the first cultivators of the pine-apple in Europe had had the means of knowing the nature of the climate most suitable to it, such as that of the West India Islands, and if in their culture they had aimed at one somewhat similar, we think that it would have been almost impossible that they should have made many trials with little or no success, for in a West India climate it thrives exceedingly well with scarcely any care. It has been grown of good size and quality in this country in various soils, differing much in their nature, as in sand, loam, peat, leaf-mould, &c.; but we are not aware that it has succeeded in any soil when a West India climate has been widely departed from; on the contrary, when considerable deviation has been made, numerous instances of failure could be adduced. The finest soil may be selected, and the utmost care bestowed as regards moisture, light, and air, but all attentions and appliances will be in

vain if the plants are at the same time subjected to a temperature which is not natural to them.

When, therefore, so much depends on a proper temperature, that which prevails in countries where it is admitted the climate is most congenial to the pine-apple ought to be known. We believe we cannot do better than direct attention to the temperature of some of the West India Islands, which is as follows:—

PLACES.	Latitude.	Mean Temperature of the Year.	Mean Temperature of the Hottest Month.	Mean Temperature of Coldest Month.	Difference between Hottest and Coldest Month.
St. Vincent,.....	13° 10' N.	81.52°	83.34°	79.27°	4.07°
St. Christopher,.....	17 44 "	81.27	84.19	78.02	6.17
St. Bartholomew,....	17 53 "	79.97	83.30	78.69	4.61
Kingston (Jamaica),	18 0 "	78.77	81.67	75.73	5.94
St. Thomas,.....	18 21 "	81.23	83.69	78.21	5.48
Average,.....	...	80.55	83.23	79.98	5.25

Taking the average of these stations, it appears that the mean temperature of the year is between 80° and 81°, that of the hottest months 83.23°, and of the coldest 78°, the mean range being 5½°. These are, indeed, very narrow limits, but the pine-apple will bear a wider range with impunity; for we find that at Nassau, New Providence, lat. 25° 16' N., the mean temperature of the year is 76.27°, that of the hottest month 83.20°, and of the coldest 70°, the difference being 13.20°. The climate of this place is therefore not so uniformly hot as the West India Islands within the tropics; nevertheless, the pine-apple thrives well, for the New Providence variety obtained from thence is one of the largest. It should, however, be recollected that in New Providence the temperature rarely falls below 65° at night, even in the coldest month of the year; and an occasional low temperature will little affect the health of a plant compared with one that is uniformly as low.

Although, as regards heat, the artificial treatment of the pine-apple may be safely regulated according to the temperature of localities naturally well adapted for its perfect growth, such as those above mentioned, yet it is not well to stimulate plants by much heat if at the same time light is deficient, as is the case in our winter, when the days are not only short but often sunless and gloomy. Therefore, under such circumstances, the lowest temperature that can be safely adopted will be most proper. This, if we are to be mainly guided by natural data, may be as low as that

to which the plants are subjected in the coldest months at New Providence. Its mean, as above stated, is 70°, the lowest at night averages about 65°, the highest in the day 75°, the difference between the lowest at night and highest in the day being consequently 10°.

With regard to the extremes during the coolest period, it may be observed that the thermometer was once so low as 58°, and only once again it indicated 60°; but these instances, it should be remembered, are rare exceptions to the general rule.

According to this a safe winter temperature for the culture of the pine-apple is 70° for the mean, with a range of 10°, that is, the lowest 65° at night, and the highest 75° in the day.

Having deduced the lowest suitable temperature, we shall now take into consideration the highest. For the mean we may take that of the West India Islands within the tropics, which, in those we have selected for data, averages 83.23°, and it is about the same at New Providence. At the latter place it appears, from well recorded observations of self-registering thermometers, that neither in the hottest months, nor indeed in any instance throughout the year, was the temperature higher than 89° in the shade. This was the extreme limit, and it was seldom reached; therefore the maximum by artificial heat should average lower, say about 87°, and then the lowest at night may be 79°, which will give 83° as the mean; the difference between the highest in the day and the lowest at night will thus be 8°, which is more than usually occurs, independent of direct solar rays, in the West Indies. But rather than use much fire heat, if that should be necessary to maintain the above night temperature, the thermometer may be allowed to fall to 75° and rise to 88°.

The natural temperature for the pine-apple, according to the above deductions, is a mean of 70° in the coldest period of the year, and about 83° in the warmest, with a range of 8° or 10° between the coldest at night and warmest in the day. As the days lengthen, the mean should be gradually raised from 70°, the lowest, till in the summer months it reach 83° or 84°, the highest; the range should be limited generally to 8° or 10°, that is 4° or 5° above the mean in the day, and as much below it in the night; thus, when the mean temperature is to be 75°, the lowest at night should be 70°

and the highest in the day 80°. On this principle the following table, exhibiting the temperature which we consider most suitable for the pine-apple, has been calculated:—

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Highest in the day,	75°	77°	80°	83°	85°	87°	87°	87°	85°	83°	78°	77°
Lowest at night,	65	67	70	73	75	77	79	79	77	75	70	65
Mean,	70	72	75	78	80	82	83	83	81	79	74	71

By sun heat, with an additional amount of ventilation, the temperature may be allowed to rise 10° higher than the maxima indicated in the above table. This would limit the highest temperature by artificial means and sun heat combined to 97°; the house may, however, in summer, be shut up at 100° in the afternoon, when the intensity of the sun's rays have diminished so much that, instead of the temperature rising higher, it will only remain stationary for some time and then gradually decline.

It is well known that not only in the tropics, but even occasionally in Britain, a thermometer exposed to the sun's rays will indicate upwards of 120°, and in warm summers here from 100° to 120° by sun heat in the open air is of frequent occurrence. This may lead to the conclusion that in our stoves the pine-apple might be very beneficially indulged with as much sun-heat as it has in the West Indies, or as much as cabbages and other hardy plants experience in the open air in our climate. Doubtless it might with advantage; yet we consider that the plants in any forcing structure will be injured if the thermometer in that structure be allowed to rise so high as 120°, although this amount is not by any means uncommon out of doors. By some that are also of this opinion, it has been urged that there is a more free circulation of air out of doors, and that being the case a high temperature does not prove so injurious. This, however, does not afford a satisfactory explanation of the point in question, for sometimes with a hot sun there is not a breath of air, or scarcely so much as would cause a poplar leaf to tremble, whilst in a ventilated hot-house the circulation of air is considerable. Further investigation is therefore necessary. Presuming the temperature of the external air, by a thermometer in the shade, to be 90°, and that shown by an adjoining thermometer exposed to the direct rays of the sun to be 120°; then, if these rays are inter-

cepted the instrument will by degrees indicate lower and lower till it also exhibit a temperature of 90°, or that of the air independent of the sun's rays; and by that temperature, likewise, every part of the surface of a plant growing freely exposed in the vicinity of the thermometers will be affected, except where the sun's rays directly impinge. In short, the temperature of the air in contact with the plant would be 90°. But a plant growing in a glass structure, with the internal temperature raised by sun heat to 120°, is in a very different condition. The thermometer in forcing-houses is usually placed with its back to the sun, so that it is not affected by his direct rays. Supposing it to indicate 90° when there is no sunshine, and then it rises to 120° after the sun breaks out, this rise must take place in consequence of the thermometer being in contact with air of the temperature of 120°, and not from the direct action of the sun's rays, for, as above stated, the bulb in hot-houses is not generally exposed. Here, then, we have the pine-apple growing, or rather suffering, in hot air of 120°, or 30° higher than is generally reached by the air in the tropics. And surely we may be contented with giving tropical plants their natural tropical heat without exceeding it by so much as 30°. "The climate of the tropics is much more characterized by the *duration of the heat* than by its *intensity*, that is, by the *maxima* of temperature which the thermometer attains on certain days. I never saw the instrument at Cumana below 69°, nor above 91°; and I found on the registers of M. Orta, whose thermometers were compared by mine with those of the Observatory at Paris, that at Vera Cruz the maximum of heat in thirteen years had only three times attained 90°, and once 96 $\frac{1}{4}$ °, while we have seen the thermometer at Paris at 101°."—(*Humboldt's Personal Narrative*, as quoted in *Daniell's Meteorological Essays*, p. 607.)

Having arrived at what we conceive to be the most suitable atmospheric temperature, we may now pass to the consideration of the proper amount of bottom-heat. In most countries the temperature of the soil, as far as the roots of the plants extend, is on the average somewhat higher than the mean of the atmospheric temperature in the same locality. In ultra-tropical countries the earth is warmer than the air from August till March, but colder during the months of

April, May, June, and July. Generally in March, and again in August, the mean temperature of the soil and that of the atmosphere are equal. The greatest difference which exists between these is in December, and then it is scarcely 4°. Within the tropics the earth is generally warmer than the air; according to the accurate observations of Dr. Joseph Hooker, made at ten stations in the plains of Bengal, the earth was on the average 3° or 4° warmer than the air.

Bottom-heat for pines should, therefore, not fall below the means in the table of monthly temperatures given above, but should range between that and the maximum temperatures. If the plants are found to be insufficiently furnished with roots, the bottom-heat should be at least as high as the maximum for the respective months. This is much higher than was formerly recommended, yet considerably below that which some now adopt. We consider it quite high enough to keep the roots at all times in good condition, and constantly in action; and this is absolutely necessary, for if they are in so cold a medium that the sap cannot flow towards the extremities of the roots, the latter become so inert as to be useless; consequently a plant well grown during the summer and well rooted before winter is reduced to the condition of a cutting, its existence depending on the roots which it may subsequently form. Pine growers used to starve not only the tops but also the roots of their plants for months previous to March; then a general shifting of the plants and renewal of fermenting materials usually took place, and with an increased bottom and top heat the plants were started to grow, but a considerable portion of the summer was spent in efforts to remedy the evils which the winter had entailed. Hence the long period formerly considered necessary to fruit the pine-apple, compared with that now required by those who maintain throughout the winter a higher bottom-heat, similar to that which we have pointed out as the most suitable.

Varieties.—These are classified as follows:—

CLASS I.

Leaves spineless.

§ 1.—Flowers purple. § 2.—Flowers lilac.

CLASS II.

Leaves with minute spines, averaging about 11 in an inch.

§ 1.—Flowers purple. § 2.—Flowers lilac.

CLASS III.

Leaves with middle-sized spines (about 6 or 7 in an inch).

§ 1.—Flowers purple. § 2.—Flowers lilac.

CLASS IV.

Leaves with large rigid spines (about 4 in an inch).

§ 1.—Flowers purple. § 2.—Flowers lilac.

In the above classes upwards of sixty varieties are comprised, but many of these are worthless, and others present such slight shades of difference as scarcely to warrant their being considered as distinct sorts; of the remainder the following are the best:—

1. **BLACK ANTIGUA**—syn. Antigua, Brown Antigua (of Speechley), Jagged-leaved Antigua, West Indian.—*Leaves* very long, narrow, acute, of a clear bluish green, the inner ones much tinged with pale brown, very mealy beneath, slightly so above; spines large, placed widely apart. *Flowers* purple. *Fruit* cylindrical, inclining to oval, of a dark yellow colour; pips very large and prominent; flesh pale yellow, sweet, very juicy, pleasantly acid, and highly flavoured. It should be cut when it begins to change to a yellow colour, or just before ripening. It attains the weight of from 5 to 6 lbs.

2. **BLACK JAMAICA**—syn. Jamaica, Black Barbadoes, Copper-coloured, St. Vincent's Sugar-loaf, Tawny, Montserrat (of Speechley).—*Leaves* long, narrow, dark green, tinged with brown, mealy; spines small, thinly set. *Flowers* purple. *Fruit* oval, somewhat pyramidal, dark brownish yellow; pips middle-sized, prominent, fattened in the centre; flesh firm, pale yellow, rich, juicy, and highly flavoured. It generally attains the weight of from 4 to 5 lbs. It swells well in winter, and the variety is one of the best for fruiting at that season, as well as in summer, but it is a rather slow grower.

3. **BLOOD RED**—syn. Claret.—*Leaves* large, purplish red; spines large. *Flowers* lilac. *Fruit* oblong, tapering a little to the crown, reddish chocolate; pips middle-sized, slightly prominent; flesh white, soft, not very rich. This variety is retained in some collections on account of its colour.

4. **BROWN SUGAR-LOAF**.—*Leaves* broad, pale bluish green, tinged with brown, slightly mealy; spines middle-sized. *Flowers* lilac. *Fruit* pyramidal, dull, reddish orange, almost without mealiness; pips large; flesh firm, deep yellow, very juicy, rich, slightly acid, and of high flavour. A handsome sort, attaining the weight of from 4 to 5 lbs.

5. **BROWN-LEAVED SUGAR-LOAF**—syn. Antigua, Sugar-loaf, Striped Brown Sugar-loaf, Mocha.—*Leaves* short, broad, dark green, much tinged with brown, slightly mealy; spines middle-sized. *Flowers* lilac. *Fruit* cylindrical, dark yellow; pips large, somewhat prominent; flesh deep yellow, slightly fibrous, rich, sweet, and excellent. Usual weight from 4 to 5 lbs.

6. **COMTE DE PARIS**. According to the *Bon Jardinier* this resembles the Queen, but the fruit is much larger, and the plants grow more freely.

7. **ENVILLE**—syn. Old Enville, Enville Sugar-loaf, Cockscorn.—*Leaves* moderately long, rather broad, bluish green, very mealy; spines middle-sized, irregular, thickly set. *Flowers* lilac. *Fruit* pyramidal, deep orange, with pale copper-coloured scales; crown small; pips middle-sized or rather large, slightly prominent; flesh pale yellow, juicy, tolerably rich, sweet, perfumed, but not highly flavoured. It generally weighs 6 or 7 lbs., and swells well in winter.

8. **MOSCOW QUEEN** differs from the Queen in having

furrowed leaves, with the veins beneath destitute of mealiness.

9. **QUEEN**—syn. Broad-leaved Queen, Common Queen, Ananas Ordinaire.—*Leaves* very short, broad, of a bluish green, very mealy; spines strong, set widely apart. *Flowers* lilac. *Fruit* cylindrical, of a rich, deep yellow; pips middle-sized, or rather small, prominent; flesh pale yellow, juicy, sweet, rich, and excellent. It weighs from 3 to 6 lbs., and the variety is one of the best and most generally cultivated.

10. **REINE POMARÉ**.—One of the new French varieties, the fruit of which is stated in the *Bon Jardinier* to be large, and shaped like the Enville, with the flavour of the Queen pine; therefore it must be considered a valuable sort.

11. **NEW BLACK JAMAICA**—syn. Brown Antigua, English Globe, St. Kitts, Montserrat of some.—*Leaves* long, narrow, light green mottled with dark green; spines small. *Flowers* purple. *Fruit* pyramidal, slightly mealy, dark orange; pips middle-sized, prominent; flesh pale yellow, sweet, rich, and highly flavoured. It generally weighs from 4 to 5 lbs., and is best adapted for summer fruiting.

12. **RIPLEY'S QUEEN**.—This differs from the Queen in having leaves of a paler colour, and less mealy; the pips also are flatter.

13. **RIPLEY**—syn. Ripley's, Old Ripley, Heaton House Montserrat.—*Leaves* rather long, broad, reflexed on their margin, dark green much tinged with reddish brown, mealy; spines middle-sized. *Flowers* purple. *Fruit* ovate, slightly compressed at both ends, of a pale copper colour; pips above the middle size, very mealy at their centre, rather prominent; flesh pale yellow, sweet, rich, and of an agreeable flavour. The fruit generally weighs 4 or 5 lbs.

14. **RUSSIAN GLOBE**.—*Leaves* rather short, broad, dull green, much tinged with dark brown, somewhat mealy; spines long, thinly set. *Flowers* lilac. *Fruit* globular, sometimes tapering to the summit, dark orange, very mealy; pips large, flat; flesh bright yellow very juicy, sweet, rich, and highly perfumed.

15. **ST. VINCENT'S**—syn. Green St. Vincent's, Bahama Sugar-loaf, Green Olive, St. Thomas', Stubton Seedling.—*Leaves* long, broad, pale green, mealy; spines middle-sized. *Flowers* purple. *Fruit* bluntly pyramidal, slightly mealy, dull yellow; pips middle-sized, flat; flesh pale yellow, juicy, rich, sweet, and highly flavoured. Its general weight is about 4 lbs. The variety is suitable for winter fruiting.

16. **SIERRA LEONE**.—*Leaves* long, broad, bluish green frequently blotched with a darker colour; spines short. *Flowers* purple. *Fruit* cylindrical, very mealy, of a dull ochre colour; pips rather small, prominent; flesh very pale, yellow, tender, juicy, and sweet. It attains the weight of 6 lbs.

17. **SMOOTH-LEAVED CAYENNE**—syn. Cayenne à feuilles lisses, Maipouri.—*Leaves* long, smooth, or with very few spines. *Fruit* very large, pyramidal, dark orange; flesh pale yellow, rich, and excellent. A very handsome fruit, averaging from 6 to 7 lbs. There is a Prickly Cayenne, but it is inferior in quality to the above.

18. **TRINIDAD**—syn. Pitch Lake.—*Leaves* very long, reflexed, broad at the base, and tapering regularly to the apex, dull green much tinged with reddish brown, mealy; spines numerous, middle-sized. *Flowers* lilac. *Fruit* of a tall, conical form, dark orange; pips large, slightly prominent; flesh pale yellow, sweet, and well flavoured.

This is perhaps the largest sort. The fruit is said to attain in Trinidad the weight of 26 lbs.

19. **WHITE PROVIDENCE**—syn. Providence, Mealy-leaved Providence, New Providence, Wollaton Providence, Wollaton Green Providence.—*Leaves* long, broad, light bluish green; spines small, numerous. *Flowers* purple. *Fruit* oblong or oval, very mealy, reddish yellow; pips large, nearly flat; flesh white, sweet, and juicy, but not highly flavoured. The fruit attains a very large size, frequently weighing as much as 10 or 12 lbs., and one was grown by Mr. Mills to the weight of upwards of 15 lbs. The variety is more cultivated on account of its magnificent appearance than its flavour.

Propagation.—This is effected by seeds, crowns, gills, and cuttings of the stem. Seeds should be sown about a quarter of an inch deep, in light rich soil mixed with leaf-mould, plunged in a bottom heat of 85°, and covered with a bell-glass. By due attention in shifting the plants as they require it, and keeping them always growing, though, of course, but slowly, in winter, seedlings may be fruited in three years.

Good plants can also be reared from crowns, but suckers are considered preferable. The crowns were formerly laid aside till they became partially dried; but it is better to pare off the base part when twisted out of the top of the fruit, and either pot them at once, or insert them in the tan-bed.

Suckers afford the best means of propagation, especially those proceeding from the lower part of the stem. They are usually taken off when the fruit is cut; but if this takes place early in the season they will make great progress in growth by being left on the stocks till September. As some of the lower leaves of the suckers have to be taken off before they are potted or planted, it will be advisable to shorten these leaves half their length a few weeks previous to the removal of the suckers from the parent plant. They should be removed by taking hold close to their base, and moving them from side to side, twisting a little at the same time. Their bases should be pared with a sharp knife, and a few, but very few, of the lower leaves taken off. They must then be potted in good rich soil, such as loam and peat, with a little sand, in 6-inch pots, or in larger or smaller ones, according to size. They should be inserted so that the bases of the leaves next to those taken off may be a little below the surface.

Gills are offshoots produced at the base of the fruit, but they take a longer time than suckers to form as large a plant.

As cuttings of the stem will furnish plants, they may be employed when neither suckers nor crowns can be had. Mr. Mills recommends the stems to be cut in lengths of 2 or 3 inches, and split longitudinally down the centre; each piece is then laid on its flat surface, and covered about 1 inch deep with heath soil.

Soil.—The soil for pine-apples should be of a friable nature, and incapable of becoming compact by frequent watering. To insure this property its composition may be either fibrous, peaty, or sandy. In either of these, if assisted by some appropriate manure, good fruit may be produced. Loam may, however, be advantageously mixed, in the proportion of two parts to one of peat. At Meudon, in France, where pine-apples of an astonishing size have been produced, the soil employed was a sandy peat or leaf-mould, obtained from a high-lying spot, where hard-wooded trees, chiefly beech, had long been growing; this heath soil therefore partly consisted of leaf-mould. Its composition is determined by M. Payen to be—

Fine sand, ...	...	...	62.0
Roots and vegetable remains, ...	...	...	20.0
Humus, ...	...	...	16.0
Carbonate of lime, ...	...	...	0.8
Matter soluble in cold water, ...	...	...	1.2
			100.0

In this soil plants of Queen pines were planted out, and produced fruit weighing 10 lbs., but it must be observed that the bed of soil was supported on planks, between which ammonia from a large mass of fermenting horse-dung and leaves could readily ascend.

The soil used for pine-apples at the Royal Gardens at Frogmore consists of rich friable loam, mixed with pigs'-dung. Mr. Fleming employs $\frac{2}{3}$ maiden loam, and $\frac{1}{3}$ turfy peat, mixed in a rough state, and placed under a wooden platform, constructed so that the dung and urine of sheep inclosed above it may pass through the compost, the latter being removed to a shed when saturated. Mr. Glendinning recommends turfy loam, deer or sheep dung, and leaf-mould, in the proportion of six parts loam to three of dung, and one of leaf-mould. Mr. Mills, who grew a Providence pine to the weight of $15\frac{1}{4}$ lbs., recommends a compost consisting of three parts of loam, three of heath soil, and one of horse-droppings, the latter having been kept dry, and mixed with the soil when about to be used; the horse manure, it may be remarked, affords ammonia,

a substance which appears to be favourable to the growth of this fruit.

Manures.—When the nature of some of the above composts is taken into consideration, it will be readily admitted that manure of a rather strong nature may be applied to the pine-apple. Plants in such composts require no other stimulus, so long as they continue to grow vigorously enough; but frequent watering, evaporation, and the absorbing action of the roots, all tend to exhaust the nutritive principles which the compost originally contained. A fresh supply therefore becomes necessary, and this can be conveyed in liquid manure. Ammoniacal manures appear very suitable for the plants at a season when luxuriant growth is desirable, and they produce a healthy green appearance in the foliage. Stable drainings will afford ammonia in considerable quantity; it is not, however, advisable to apply this manure in an undiluted state; the admixture of two parts of water to one of urine constitutes a safe application. Liquid manure can also be formed by mixing dung of horses, cows, sheep, or poultry with water, in a tank or large cask. A little carbonate of ammonia dissolved in water, at the rate of 1 oz. to 4 gallons of water, and applied once a month, will likewise prove very beneficial. As the pine-apple has been found growing close to the sea-shore, it is probable that common salt, and some other saline manure might be applied with advantage, but we would not recommend any one to use them until he has carefully experimented with one or two plants; and, to guard against hasty conclusions, it must be borne in mind that a pine plant may be injured without exhibiting any signs of such being the case for months afterwards.

Cultivation.—This essentially consists in keeping the roots of the plants in proper soil, maintaining a proper temperature by some of the various modes of supplying top and bottom heat, and affording moisture to the roots in proportion to the amount of evaporation, much more being necessary when the plants are growing rapidly than, when under a lower temperature, they are only required to grow but slowly; more when the pots are filled with roots than when there are few of these; and it must be withheld during the ripening process, and then, only, a dry atmosphere should prevail. The foliage must be kept clean, and exposed to as much light as is possible, except in the case of plants striking root. The

sun's rays should be freely admitted; but in proportion to their intensity, care must be taken to give air sufficient to prevent the temperature from rising too high.

Various soils or compositions have been pointed out above as suitable for the pine-apple. They are such as experience has proved to be so, but others may be employed with equal success; they should, however, be tried before they are adopted for the general stock of plants. Soils may appear very similar to those recommended, and may yet contain some principle which the plants do not like, or they may be deficient in some essential quality. Therefore, when plants are seen not to be thriving, although under favourable circumstances in other respects, they should be shifted into fresh soil, and that at any period of their growth if done carefully; even when the fruit has been swelling we have known instances of plants having been shifted with advantage.

The temperature should be carefully attended to, so as to avoid extremes, either in consequence of excessive heat from the sun's rays in the day, or from too low a temperature at night. Excessive heat in the day must be counteracted by a gradually increased amount of ventilation, for, if the temperature can be kept within proper limits, the sun's rays should by no means be excluded. In certain cases when air cannot be admitted so as to have the desired effect, as in very hot weather, or where the construction of the house is such that with all the air that can be given the temperature cannot be kept below 100°, then a shading of some thin material may be employed, in order to prevent the air of the house from rising above that point. When the external temperature is as high as 80°, or nearly so, air may be given freely, provided a rush of it is not suddenly admitted when the atmosphere of the house is much higher. The greater the disparity between the heat of the internal and external air, the more cautiously should the latter be admitted. When the sky is clear, with bright sun, and when, at the same time, the wind is very cold and dry, it may be advisable to use a slight shading rather than introduce much air of that description. If, however, the air can be warmed previous to its coming in contact with the foliage, it may then be admitted to any desired amount.

There should always be a good command of bottom heat. When this is obtained by an

arrangement of hot-water pipes, and provided the arrangement is good, there can be no difficulty in regulating the bottom heat; but when it is derived from tan, or other fermenting materials, its regulation is somewhat precarious. Tan is cheap, and a quantity of it should always be in readiness to supply any deficiency that may occur. Tan and other fermenting substances may, on the contrary, get too hot; in that case they should be removed from contact with the pots, either wholly or in part, according as the heat is more or less in excess of what it ought to be. It is a good plan to plunge a small pot, with its mouth upwards, and on this place the bottom of the pot containing the plant.

Light.—To this the foliage cannot be too much exposed. The plants belonging to the young stock should be placed within 6 or 8 inches of the glass, and all others must be as near it as their height will permit. Mr. Fleming strongly recommends the plants to be as much exposed to light as possible. The surface of the bed of soil in which the pines are planted out at Trentham, is not more than 18 inches below the wall-plates. The plants should have room to permit the leaves to take their natural mode of growth, that is, to spread themselves in such directions as will insure to their aggregate surface the greatest amount of light. The whole plant naturally inclines towards the side where the strongest light falls; therefore it may here be remarked, that in re-setting after shifting, the same side of the plants should be placed next the south as before.

After continued dry weather, the glass, from not being washed by rain, becomes dusty outside, and in winter it is apt to get blackened with soot and smoke. In impinging on the clean polished surface of the brightest glass, a considerable portion of the rays of light are reflected, and consequently lost as regards their effects on plants inside the house. This is unavoidable; but not so the additional loss from dust, soot, and other substances lodging on the glass, and rendering it scarcely transparent; all such ought to be removed.

Moisture.—Formerly moisture was very sparingly given to pine plants for fear of their damping off—a circumstance which one might suppose would not be likely to occur, taking into consideration the great amount of strong fibre which the leaves contain. If they are in a healthy growing state, they require plenty

of moisture; but when in a perishing condition, either from want of sufficient bottom heat or top heat, or perhaps suffering from a deficiency of both, then, not being in a condition to evaporate moisture, this can only assist the process of decay. In winter, it was formerly almost prohibited, and under the circumstances it was no doubt advisable; but when a proper temperature is maintained, if the soil is dry, it may be safely moistened thoroughly. In winter, care must be taken not to give any more than is absolutely necessary; but in summer greater freedom may be taken; for if the soil is of the proper texture, and the drainage good, there is little danger of the former remaining in a saturated condition. Just before the fruit begins to ripen, water must be withheld, otherwise the flavour of the produce will be deteriorated. The water supplied to the roots should be about the same temperature as the soil, and that employed for syringing the foliage ought to be as warm as the atmosphere of the house or pit. This should never be allowed to get too dry. In summer, except when the weather is very wet and damp, the house may be filled with steam every afternoon, as soon as the temperature has so far declined from the maximum, that the house may be shut up immediately after steaming without danger of raising the temperature too high. If on the following morning the air of the house is found to be getting too dry, which can easily be ascertained by means of the hygrometer, or even by the rapidity with which water sprinkled on the paths is observed to evaporate, moisture should be supplied by syringing the surface of the bed, paths, &c. If the days are cold, except in extreme cases, coverings cannot be employed; but in cold nights the warmest covering at command would be highly beneficial as regards both the temperature and moisture of the internal air. If the glass could be kept as warm as the air inside, no heat would be radiated by it, neither could it act as a condenser of moisture. So far, therefore, as the roof is concerned, the temperature and moisture of the internal air would remain unchanged. A single layer of mat will prevent radiation from the glass to a considerable extent; but a much warmer covering might be devised and employed with economy, by saving fuel, and with great benefit to the plants, by preventing the air from becoming dry to such an injurious degree, as is sure to be the case when cold glass,

acting as a condenser, robs the internal air of its moisture. Pine stoves can never be called perfect as long as they are constructed without adopting means by which some covering may be readily applied, so as to prevent radiation at night.

By attending to what has been above stated of the soil and climate suitable to the pineapple, any one may grow it to good perfection without much risk of failure. It should be remembered that it does not require a season of rest like the hardy plants of ultra-tropical climates. On the contrary, it must be kept continually in a growing state. It should not of course be much excited in winter; but, at the same time, it ought not to be subjected to a lower temperature than that which occurs in countries to which it is indigenous; and if it is kept near the lower limit of that temperature, there will be no danger of the plants making too rapid growth.

It was formerly the practice either to starve or parch the plants in order to start them into fruit; but such is not now the case; and by how much the modern systems are superior to the many which preceded them, may be inferred from the resulting productions.

In conclusion, we shall briefly notice the system which has been so successfully practised at Meudon, and that of Mr. Hamilton.

Meudon System.—The suckers are potted in 4-inch pots immediately after the fruit is cut, in August or September, the earliest period being preferred, and in these they remain till spring. In March or April, a bed is prepared, half dung and half leaves, and covered with 10 inches of peat soil. In this the rooted suckers, turned out of the 4-inch pots, are planted for the summer. In October, they are carefully taken up with a little soil at their roots, which are left entire, and potted into 7-inch pots, and there they remain during the winter. In the following spring, when the plants show fruit, generally in March, a number of the strongest are finally planted out of the 7-inch pots into beds of peat soil, in houses, where they ripen their fruit in the course of the season.

The plants not selected for planting out are fruited without being turned out of the pots. Beds half dung and half leaves are prepared in March, and when they are in a proper condition as regards heat, the pots are plunged, and in these pots the plants are fruited.

From what has been stated, it will be understood that the plants are always in pots during the winter. Commencing with the suckers, they are planted in the early part of autumn in small pots, in which they remain for the *first winter*, and become rooted plants. In spring, they are turned out of their pots into peat soil, in which they grow freely, during the *first summer* of their distinct existence. In October, they are all taken up, re-potted, and again kept in pots during the *second winter*. In the *second summer*, the strongest are planted out for fruiting in the beds, and those not planted out are fruited in 7-inch pots.

Whilst the results of M. Pelvilain's simple mode of cultivating the pine-apple were astonishing even the best cultivators in this country, we observed that his system, with slight deviations, was being adopted in various forcing establishments near Paris. At the gardens of the Palace of Versailles, the plants in one house were planted out of the pots into peat soil laid on stable litter for bottom heat. In forming the bed, the litter was well beaten. Cayennes and other large sorts were the kinds planted out, some of them in January, after their fruits were formed; and in March following, when we had an opportunity of seeing them, their fruit was swelling exceedingly well.

The system pursued by M. Truffaut, a very intelligent and enterprising market-gardener at Versailles, is briefly as follows:—The suckers are potted in 3-inch pots in autumn, and planted out in April in a bed, where they are allowed to grow till the end of October. They are then taken up, disrooted, and potted in 7-inch pots, in which they are kept till March or April, when they show for fruit. They are then turned out of the pots into a bed of sandy peat, supported by wood and tiles, over a chamber heated by hot water in open troughs.

Hamiltonian System.—The system adopted by Mr. Hamilton essentially consists in fruiting the suckers without detaching them from the old stool. At the last shifting, the plants are potted rather deeply, so as to allow room for soiling up after the first fruit has been cut. After cutting, some of the bottom leaves are taken off as high as where the roots appear, which is generally two or three inches above the top of the pot. The stem is then earthed up, and new roots are soon thrown out from the bared trunk into the fresh soil. Mr. Hamilton endeavours to keep the soil moist by frequently syringing over the leaves with

lukewarm water. By attending to watering, keeping a moist atmosphere, &c., the suckers grow rapidly and perfect their fruit generally in from eight to twelve months from the time the first fruit was cut. Thus two fruits have been obtained, one in the first season from the original plant, and one in the second season from a sucker produced by it. After the second cutting, the soil is removed to the roots of the original stool, the latter is placed in a larger and deeper pot, some of the bottom leaves are removed from the base of a sucker intended to produce fruit, and fresh compost is employed in earthing as before, and thus a third fruit is produced. A fourth is obtained in a similar manner, and then the sucker which bore it is cut off, together with 6 or 8 inches of the old trunk, and potted, in order to produce a new progeny of suckers.

Insects.—The white scale (*Coccus Bromeliæ*) and the mealy bug (*Coccus Adonidum*) are the principal insects by which the pine-apple is liable to be infested. Both of them are very injurious and difficult to eradicate; but their destruction is possible, and has been completely effected even in severe cases. Great care should be taken to prevent, if possible, the existence of these pests, and, at all events, vigilance should be used to detect them on their first appearance. The plants should be frequently and carefully inspected through a microscope, so that remedial measures may be adopted before the insects become so numerous as to affect the health of the plants.

In order to prevent the attacks of insects, the plants should be occasionally washed with water of the temperature of 100° by means of an engine with a flexible tube and fine rose, which should be held near the plant. The rose being fine, the water may be strongly urged and directed against both sides of the leaves. The tube should also have a nozzle, terminating in a small orifice, for the purpose of passing a stream with considerable force into the axils of the leaves. When this is to be used, the plant may be taken up and supported at a convenient height with the bottom of the pot upwards, so that a stream of water can be played into the axils of the leaves from below. The mealy bug, if it exist there, will be driven out by the mechanical force of the water.

The steam of fermenting fresh hot dung was successfully employed by Baldwin, one of the best pine-growers of his time. He put the

plants bottom upwards over the fermenting dung in a frame, which was then closely shut up and covered with mats, for about an hour; the plants were then taken out and washed. This treatment, he states, will kill every insect. With the same object in view, pine plants may also be syringed with water of between 120° and 132° , but certainly not exceeding the latter temperature.

Mr. Curtis states, that a wash consisting of lime, black sulphur, and water, is successfully employed in Holland. The ingredients are mixed in the proportion of 2 quarts of lime and 2 oz. of sulphur to 16 gallons of water, and after having been well stirred up and allowed to settle, the wash is fit for use.

PLUM.—The directions given for forcing the cherry will on the whole apply to the plum. It should, however, be recollected, that the plum—the green gage, for example—blossoms, on the average, ten or twelve days earlier than the May Duke cherry; therefore it may be concluded that the plum requires a lower temperature than the cherry from the time the flower-buds begin to swell, and until the fruit is fairly set. The rearing, pruning, and shifting are conducted on the same principles, and the same routine should be followed. With regard to watering, great care is necessary, as the fruit of the plum is sometimes apt to crack when the tree is subjected to vicissitudes of moisture and dryness. Take, for example, the case of plums growing in the open air; when heavy rains fall whilst the fruit is ripening, it is very apt to burst if the season has been previously so dry that the roots have not had sufficient moisture; but with the same amount of rain falling during the ripening period, the fruit is not liable to be so affected after a summer during which the roots have had all along a due supply of moisture. Out of doors it is not always possible with the means at command to regulate the quantity of moisture, but in the case of trees that are being forced, water, it is presumed, will always be at hand, so that it can be readily supplied; and care should therefore be taken that it is supplied when wanted. There are many varieties of plums eligible for forcing; none, of course, but first-rate sorts as regards quality should be chosen; such are the Green Gage, Royale Hâtive, Kirke's, and the Jefferson. The early Orleans might also be included, on account of its earliness and productiveness, as well as the fine bloom on the fruit.

RASPBERRY.—Plants of this may be forced along with the gooseberry and currant, or they may be planted along the front of a pit, and trained to a trellis under the glass. But they bear very well in pots, and as these can be removed when the crop is gathered, this is the most convenient plan. As soon as the wood is matured, in autumn, the plants should be taken up and potted in 13-inch pots. In doing this, buds on the roots, likely to produce suckers, ought to be picked off. The soil used in potting should be a mixture of turfy loam of a friable nature, peat or leaf-mould, and sand. The canes may be shortened to 3 or 4 feet in length. The pots should be placed where they can be protected from frost and snow till such time as they can be introduced into the house. If this be done in January, ripe fruit may be obtained in the beginning of April. Or if introduced into gentle heat in February, with a little assistance in dull or severe weather, well flavoured fruit may be obtained in May. The plants should be duly attended to with water, of which they will require a good deal when in full growth, and until the fruit begins to colour. Suckers must be carefully removed as soon as they make their appearance. Potting the plants early in autumn is the readiest plan; but plants established in the pots in the course of the summer will stand forcing better. Suckers ought to be planted in large pots in autumn or early in spring; and at the same time the bearing wood should be cut away, in order that the canes intended to bear when forced may have every advantage.

The Red Antwerp is, in our opinion, the best sort for forcing, on account of its fine aroma.

STRAWBERRY.—Before detailing the modes adopted in forcing the strawberry, some remarks are necessary in order that certain principles may be understood; for, unless they are, success is uncertain, and failure probable.

The strawberry, for forcing, is usually propagated by runners, the first or earliest rooted of these forming the strongest plants. The earlier in the season the runners are established the longer the period of growth, and the greater the amount of light to which the foliage of the plants will be exposed before they become insensible to its effects. In proportion to the intensity of light and the period to which the plants are duly exposed to its action, so will be the quantity of elaborated sap stored

up in the roots and stem, constituting the power of the latter to throw up a vigorous scape, capable of supporting large fruit, whether by the natural heat of the season in the open ground, or by an imitation of it by artificial means.

In order that these means may be judiciously applied, it is further necessary to observe, that although the plants are vigorous, with large well-formed buds, capable of producing blossoms that would set their fruit well, yet, without a knowledge of the mode of growth, the whole or greater part of the blossoms may be rendered abortive. This is well explained by Dr. Lindley, who says, "Those who would understand the philosophy of strawberry forcing should begin by the beginning, and first determine what it is which they have to deal with. This can only be ascertained by examining the young flower buds as they exist in the plant when it makes its first move towards growth. At that time they are collections of tiny scales, placed over a small spongy centre. By degrees they take on the forms of calyx, corolla, stamens, and pistil. They form successively in the order in which they are named, the calyx first, the pistil last. The calyx and corolla are the most simple, grow the quickest, and most easily bear to be hastened; stamens require more time for growth, the pistil most of all. When high temperature, night and day, with abundance of moisture, and as much light as February yields, are suddenly applied to the strawberry, it is compelled to grow; the predetermined parts advance, and, obedient to the influences which their nature cannot disregard, they by degrees unfold. But how? The oldest parts, namely the calyx and corolla, simple in structure, and already advanced in their formation, suffer no injury, but appear in their usual state, arraying the blossom in gay apparel of white and green. The next, however, the stamens, having less time to form, acquire perhaps their yellow colour, but are powerless for their allotted office; while the pistil, the most complicated of all the parts—that which demands the longest period for its perfect formation, but which is the latest that the flower produces, and which is to become the fruit—is a mere tuft of abortions, incapable of quickening, and shrivelling into pitch-black threads as soon as it is fully in contact with the air."—*Gardeners' Chronicle*, 1847, p. 235.

From what has been stated, it is evident

that the main points to be kept in view in forcing strawberries are, 1st, to have strong, stocky plants, the leaves of which have been well exposed to light; 2d, to grow them slowly till fruit is set, in order that the parts of fructification may have time to form, as they naturally do, in gradual succession. The first consideration ought therefore to be directed to obtaining plants with good substantial stems and well-formed heart-buds. This requires the plants to be propagated as early in the previous season as possible, and their growth promoted by every possible means. If the weather is dry, the plants from which the runners are to be layered should be kept watered. Plants in young plantations, such as have been planted one year, or not more than two, throw out stronger runners than those that are older, and advantage should be taken of the earliest. By the time they have pushed a joint, some good rich loamy soil should be got in readiness, and a number of 3-inch pots. If moss can be easily procured, a little of it put in the bottom of each will serve for drainage, otherwise a few crocks, or some bits of old turf may be employed. The pots should be filled with soil, plunged a little in the ground by means of a trowel, or other tool adapted for the purpose; but in doing this, care must be taken not to injure the roots of the strawberry plants near which the pots are plunged. The joint of the runners should be inserted slightly in the soil of the pot, and kept down, either by hooked twigs or small stones, as explained in treating of the culture of the strawberry in the open ground. If the soil in the pots is kept moist the runners will soon take root. The point of the runners beyond the joint should be stopped, so that the nourishment derived from the mother plant may be concentrated wholly in the one layered. When the plants are well-rooted, nearly occupying the small pots, they should be shifted into 6-inch pots. In doing this, the pots should be properly drained, and good turfy loam, mixed with some leaf-mould or well rotted cow dung, employed for filling them. If rough turfy loam and cow dung is made into a compost six or twelve months previous to its being required for the purpose, so much the better. One plant in each pot will be sufficient. The plants when potted may be placed out of the sun's rays till they recover their shifting; they should then be placed in an open space with a hard surface;

if otherwise, it ought to have a covering of coal ashes, to prevent the worms from working up into the pots, and quicklime may also be sprinkled over the surface. The pots may be placed tolerably close at first, but as the plants grow larger they should have more space allowed, so that the foliage may have plenty of light and air. They should not be allowed to root through the pots, which they will be apt to do in wet weather; and in this case it is a good plan to lay the pots on their sides, by which means the roots are prevented from striking into the ground, and the soil from being washed and soaked with moisture.

On the approach of winter, when the leaves mostly decay, and the season of growth is over, the pots should be placed in a temporary pit, where they can be protected, so that the soil in the pots cannot get frozen. Where there is not the convenience of pits, the pots may be laid on their sides above each other, with their bottoms against a wall, coal ashes, old tan, or leaves being interposed between the sides. Some stack them by placing a row of pots on their sides, then another row with their bottoms against those of the first, any substance that will not readily freeze being laid or stuffed among the pots. Before the plants are taken in to force, the pots should be cleaned, and a little of the mould at top taken off and replaced with rich soil. The crowns of the plants before they start into growth may be covered with half decayed leaf-mould.

When introduced below glass the temperature should not exceed 50° or 55° by fire heat. Air must at all times be freely admitted, but of course much less will suffice when the weather is cold than when it is warm. The temperature and air should be regulated by the appearance of the foliage. If the leaflets are observed to be broad, yet of thin substance, and if the leaf stalks are drawing up, as if likely to be taller and more slender than those in the open ground, less fire heat and more air must be given.

When the flower-buds begin to open, forcing must be conducted very slowly for the reasons already stated. If it is, every flower will set, or at least as many as the plants ought to bear. The upper portions of the flower-stalks are inclined to continue flowering in succession; but these later productions should be clipped off, for they only rob the fruit previously formed, while they themselves never acquire perfection.

After the fruit is set, the temperature should be gradually increased, and towards ripening it may be raised to 65° , and occasionally as high as 75° by sun heat. The plants should never be allowed to get even once too dry, for if they are, the growth of the fruit will not afterwards progress so favourably, neither will the flavour be so good as if vegetation had received no such check. Excessive dryness should always be prevented, for after it has taken place, it cannot be completely remedied. When the fruit begins to colour, no more water should, however, be given than is absolutely requisite to keep the leaves from flagging; the quantity must depend upon the temperature and dryness of the air, or, in other words, upon the amount of evaporation. This must be supplied, especially during hot sun, even during the period of ripening, otherwise the fruit would get heated, and if that is the case, the flavour becomes less delicious. The fruit ought to be gathered in the morning. As the crop is gathered from the pots, these should be immediately removed from the house.

Various other modes of proceeding may be successfully adopted in preparing the plants for forcing. Instead of layering the runners for plants to be forced in the ensuing winter and spring, runners may be planted out in August, the plants taken up just before they begin to grow in spring, potted in 5-inch pots, and shifted into 6-inch ones towards the end of July. In this month the spring foliage begins to get too old, and the plants are disposed to start a second growth of young foliage. This is favoured by the shift into fresh soil and larger pots. By means of fresh foliage fresh roots are produced, and these are much better adapted for feeding the plant when being forced than older roots are.

Where there is not a sufficient supply of pots, or a scarcity of hands to attend to potted plants, young plants from runners may be put in about 8 inches apart, in rows 15 or 18 inches asunder; neither fruit nor runners should be allowed to grow on these in the following summer; a portion of the oldest foliage of each plant should be cut off in July, and a top-dressing of rich soil or leaf-mould and loam ought to be given close up to the necks of the plants, to encourage fresh roots from that part. These plants may be taken up in oblong strips about 1 foot wide, and placed near the glass in a pit, closely side by

side on some gently heating material, or on a platform with a hot-water pipe below. The heat from the latter should not exceed 60°.

Various other plans may be followed in forcing strawberries, for if the main principles are attended to, modifications, as regards minor points of detail, may be varied according to means at command and other circumstances. We have known patches cut out of a plantation with the spade, potted into 8-inch pots, and immediately taken in to force; the crop was very good, although the fruit was not so large as from plants nursed up for the purpose. In France, strawberries are sometimes forced by dung heat in the beds where they are growing in the open air; and where stable manure is plentiful this might occasionally be adopted in this country. Frames are placed over the bed, trenches 18 inches deep are dug out round the outside of these, and filled in the first instance to the level of the surface with hot dung, and afterwards to the height of the frames if necessary, to maintain the proper temperature. At night the sashes are covered with straw mats. In order to obtain a second crop from the beds so forced, the plants are kept dry for some time after the forced crop is gathered; the old leaves are cut off, a top-dressing is given, water supplied, and in August a fair second crop is frequently obtained. The Roseberry, it may be remarked, is particularly disposed to yield a second crop.

The sorts of strawberry chiefly employed for forcing are the British Queen and Keens' Seedling. The Grove End Scarlet is a most abundant bearer, and although not so eligible for the dessert, is nevertheless very useful for the purposes of the confectioner.

THE VINE (*Vitis vinifera*, L.—Pentandria Monogynia, L.; Ampelidæ, D. C.; Vitaceæ, Lind.) is a deciduous, hardy, climbing shrub or tree, a native of the shores of the Caspian, but not indigenous to Europe. Michaux found it in the woods of Mazanderan, and Olivier saw it in many parts of the mountains of Kurdistan. Humboldt states that it grows wild on the coast of the Caspian, in Armenia, and in Caramania, but does not belong to Europe.

According to Sickler, its cultivation extended from Asia to Egypt, from thence to the southern parts of Europe through Greece. From Italy it progressed northwards into France, and in all probability it had been tried in Britain by the Romans, but possibly with-

out success; for varieties suitable for the warm climate of Italy would be likely to fail in maturing their fruit in the moist climate of our island, as indeed is stated by Tacitus to have been the case. In the year 85, Domitian prohibited by an edict the planting of any new vineyards in Italy, and ordered those existing in the provinces to be destroyed. This edict was rescinded by Probus in the year 280, and Britain is particularly mentioned among the provinces which enjoyed the privilege of being allowed to cultivate the vine. Vineyards are mentioned by Bede (before A.D. 731) as existing in several parts of Britain. In 1140, barons as well as monks possessed vineyards; by the latter, wine was made in good, and verjuice in bad seasons; and from the hardier sorts of Burgundy grapes, planted in the most appropriate situations—and in regard to this the monks were careful—a tolerably good wine may have been produced, better no doubt than some artificial champagnes of the present day.

Under favourable circumstances, the vine lives to a great age. Pliny mentions one 600 years old; vines 100 years old are accounted young in the vineyards of Italy; and Bosc states there are some in Burgundy upwards of 400 years old. The celebrated vine at Hampton Court was planted in 1769, and is yet bearing annually a large number of bunches; and though not so large as those obtained from young vines, yet their aggregate weight is still very great for one plant to bear.

Varieties.—The varieties of wine grapes are exceedingly numerous, as are likewise those for table use. Of the former, little need be said in this work; of the latter, the following are some of the best for cultivation in this country, on the open wall and under glass:—

CLASS I.—GRAPES BLACK.

1. **BLACK HAMBURG**—syn. Warner's Black Hamburg, Red Hamburg, Brown Hamburg, Purple Hamburg, Dutch Hamburg, Hampton Court Vine, Valentine's, Black Portugal, Black Gibraltar, Black Teneriffe, Victoria Hamburg, Admiral, Salisbury Violet, Frankendale, Frankenthaler, Frankenthaler gros Noir, Troller, Trollinger, Pale-Wooded Trollinger, Welscher, Schwartzwelscher, Fleish Traube, Hudler, Languedoc, Schwarzer Gutedel of some, Gelbholziger Trollinger, Bocksaugen, Bommerer, Lugiana Nera.—*Leaves* large, with three principal lobes, the middle one tapering and elongated, smooth above, slightly pubescent beneath; footstalks long. *Bunch* large, shouldered. *Berries* large, round when well grown, otherwise occasionally somewhat oval; on the contrary, when highly fed they become ob-

late, measuring less from the stalk to the opposite end than transversely, and the surface is rendered uneven, like a hammered bullet. Skin black, covered with a copious bloom, rather thick, unless allowed to hang till at the point of commencing to shrivel; it is only then that the fruit is perfectly ripe, and the flesh acquires to the fullest extent its rich and delicious flavour; but it may be affirmed that nine-tenths of the produce of this excellent variety is consumed when only well coloured, and even in that state it is considered good. The vine, it is well known, is very vigorous and productive.

2. **WILMOT'S BLACK HAMBURG**—syn. Wilmot's Dutch Hamburg.—*Berries* larger than those of the Black Hamburg, firmer fleshed, but not of such good flavour. It requires a high temperature and an abundant circulation of air to ripen and colour it well. On the whole the Black Hamburg is preferable.—*Pope's Hamburg, Mill Hill Hamburg, and Judson's Richmond Villa Hamburg.* There is no material difference between these and the Black Hamburg, nor do they possess any superiority of flavour over it.

3. **MUSCAT HAMBURG**.—*Leaves* large, deeply three-lobed, nearly smooth above, pubescent beneath; ribs set with short bristly hairs. *Bunch* long, tapering, and shouldered. *Berries* large, oval, black; flesh of the consistence of that of the Black Hamburg, very rich, with a decidedly muscat flavour. This excellent variety is stated to have been raised from the Black Hamburg, crossed with the Muscat of Alexandria, in consequence of which the rich muscat flavour of the latter has been imparted to the Hamburg breed, and a great desideratum obtained. It fruited for the first time in 1848, and produced fruit of great excellence in an old house, it was stated, without fire-heat. It is one of the best new grapes in existence, in fact we think the very best as far as we are aware.

4. **BLACK PRINCE**—syn. Alicant, Black Spanish, Black Lisbon, Black Portugal, Black Valentia, Lombardy of some, Poeock's Damascus, Cambridge Botanic Garden, Sir Abraham Pytche's Black, Boston.—*Leaves* deeply lobed, sometimes open at the base, but generally overlapping, pubescent; the ribs are slightly bristled; petioles tinged with red. *Bunch* very long and tapering, sometimes shouldered. *Berries* oval, bluish black, covered with a copious bloom; flesh purplish immediately under the skin, juicy and rich when fully ripe; but it is not so sweet as the Black Hamburg when eaten like it in a well-coloured but not ripe state. Under favourable circumstances it will keep sound on the vine for a considerable time after being ripe. The tree is a good bearer, and the fruit will ripen on the open wall in warm seasons. Late in autumn the leaves acquire a bright crimson colour. Sometimes the Black Hamburg does not colour well, and it is therefore advisable to have some plants of the Black Prince from which a supply of well-coloured fruit may be depended on.

5. **BLACK ST. PETER'S**—syn. St. Peter's, Black Palestine, Oldaker's West's St. Peter's.—*Leaves* not deeply cut, but acutely serrated, open at the base—that is, the portion on each side of the footstalk not overlapping, smooth above and also beneath, with the exception of a slight pubescence on the ribs. When mature and fading, the leaves assume a purplish crimson hue. *Bunch* middle-sized, sometimes rather large, and in that case shouldered, but generally not so. *Berries* round, inclining to oval; skin rather thin, black, with a fine bloom; flesh purplish, sugary, and rich. The variety is a good bearer, and valuable on account of the fruit hanging late,

for which reason it is now extensively cultivated. If the vine is not forced in the early stage of its vegetation, and the house be kept free from damp in winter, the fruit will hang and remain in a sound condition till February or March, when the new crop of early forced grapes comes in for use. Although for late keeping it should not be forced early, yet care must be taken that in its more advanced stage it have heat sufficient to ripen it properly before the leaves begin to lose their action; then the temperature should be gradually lowered.

6. **ESPERIONE**—syn. Turner's Black, Turner's Early Black, Cumberland Lodge, Hardy Blue Windsor, Red Port of some.—*Leaves* roundish, with five moderately deep lobes, pubescent on both sides; the footstalk is also pubescent, and of a purple tinge; wood somewhat striped with purple. *Bunch* large, shouldered, or without shoulders if the bunches are very numerous, which they generally are if not thinned off. *Berries* round, black, covered with a profuse bloom; flesh sweet and vinous, but rather acid long after colouring. The vine is vigorous and hardy, bearing abundantly, and ripening in the open air on a good aspect. It is well figured in the *Transactions of the Horticultural Society*, vol. iii. p. 93.

7. **BLACK FRONTIGNAN**—syn. Purple Frontignan, Purple Constantia, Black Constantia, Red Frontignan of some, Sir William Rowley's Black, Muscat Noir, Muscat Noir Ordinaire, Muscat Noir de Jura, Muscat Rouge of some, Boudales des Hautes Pyrénées, Schwarzer Muscateller, Schwarzer Weihrauch.—*Leaves* roundish, sharply serrated, but not deeply lobed; midribs smooth. *Bunch* middle-sized, tapering. *Berries* round; skin black; flesh moderately firm, with a rich muscat flavour, on which account this excellent variety ought to be included in every good collection.

8. **BLACK MUSCAT OF ALEXANDRIA**.—This in size, form, and quality is similar to the White Muscat of Alexandria, the only difference being in regard to colour. It is not generally cultivated, probably owing to its requiring much heat, and yet not always colouring well; and when that is the case, although its flavour may be good, its appearance is inferior to that of the white variety, which is accordingly preferred.

9. **BLACK MOROCCO**—syn. Black Muscadel, Ansley's Large Oval Black, Le Cœur, Raisin d'Espagne.—The names of Black Raisin, Black Gibraltar, and Red Muscadel have also been applied to it by some, whilst by these appellations totally different sorts have been designated by others. *Bunch* very large, shouldered. *Berries* very large, oval, black; pulp firm, sweet. This grape has a noble appearance, but it is a bad setter. It should be fertilized with the pollen of the Hamburg, and receive as much heat as the Muscat.

10. **EARLY BLACK JULY**—syn. Maurillon or Morillon Hâtif, Madeleine, Madeleine Noir, Raisin Précoce, De St. Jean, De Juillet, Sehr Früher Schwarzer Burgunder, Früher Burgunder, Champagner, August Traube, Augustiner, August Clevner, Jacob's Traube, Früher Morchen, Ranczi, Juannens Negrés, Luviana, Lugiana Veronese, Lugliana and Lugliola del Toscani.—*Leaves* small, some slightly, others rather deeply three-lobed, smooth above, slightly pubescent beneath; leaf-stalks stained with red. *Bunch* small. *Berries* small, round, not so closely set as in the Black Burgundy; flesh juicy and sweet.

11. **BLACK CLUSTER**—syn. Burgundy, Black Burgundy, True Burgundy, Early Black, Small Black Cluster,

Black Morillon, Auvergne, Auvernat, Auvernat Rouge, Vrai Auvernase, Pineau, Raisin de Bourgogne, Saumouveau, Bon Plant, Genetin de St. Menin, Fin Noir de Toulon, Talvagnues Rouge, Terment, Noirin, Pignolet, Klevner, Augustiner, Blauer Seeklevner, Schwarzer Süssling, Klebroth, Schwarzer Rissling, Schwarze Fränkische.—*Leaves* nearly smooth, rather deeply lobed, but having shallow serratures. *Bunch* small, compact. *Berries* rather small, roundish oval; skin deep black, thick; flesh sweet, juicy, and rich. This is a very old variety, and one of the hardiest known. In this country its wood becomes firmer and better matured in the open air than that of any other kind; and as the fruit ripens early, it is perhaps the best wine grape that can be grown in climates not very favourable for the vine.

12. MILLER'S BURGUNDY—syn. Black Cluster (of Miller), Miller, Aleatico du Pô, Le Meunier, Fromenté, Maurillon Tacconé, Resseau, Farineux Noir, Savagnien Noir, Noirin, Müllerrebe, Müllerweib, Pulverulenta, Morone Farinaccio.—*Leaves* downy above, hoary with down beneath, nearly white, in allusion to which appearance it has the name of Miller's grape, or one with that signification in various languages. *Bunches* short, ovate, compact. *Berries* small, round, or inclining to roundish oval; skin thin, black; flesh tender, with abundance of juice, which is rather sharp long after the fruit is coloured, and when fully ripe it is not so sweet as the Early Black July and Black Cluster. The variety, however, is hardy, and is one of those suited for cultivation against walls in the open air; or it might be grown for wine in warm, sandy, or chalky soils.

13. TRENTHAM BLACK.—*Leaves* below the middle size, bluntly lobed, dark green, and of thick texture. *Berries* middle-sized, roundish; skin thin, purplish black, with a copious bloom; pulp juicy, rich, and vinous. Bears forcing well, ripening as early as the Hamburg, and hanging longer; the latter property renders it valuable.

14. BLACK BARBAROSSA.—*Leaves* large, downy. *Bunch* very large, rather loose. *Berries* large, somewhat oval, black, moderately juicy, but in point of flavour not equal to the Black Hamburg and many others. It can only be recommended as a late grape.

15. LARGE BLACK FERRAL.—A very strong growing sort, that ought not to be planted in the same border with others, for it would rob them, unless its roots were partitioned off. *Leaves* very large. *Bunch* of the largest size, with long shoulders. *Berries* large, oval; skin thick, black or dark red; flavour tolerably rich. Requires a strong heat, and is only fit for a late house.

16. LADY DOWNE'S SEEDLING.—*Berries* large, roundish oval, purplish black; pulp rather firmer than that of the Black Hamburg, rich and excellent. One of the best sorts for a late vinery.

CLASS II.—GRAPES GRIZZLY.

17. GRIZZLY FRONTIGNAN—syn. Red Frontignan, Red Constantia, Muscat Gris, Muscat Rouge, Moscado Rosso, Moscatel Menudo, Kümmel Traube, Brauner Muscateller, Grauer Muscateller, Rother Muscateller of some, Rother Schneekende, Rother Weirauch, Grizeline.—As regards the *leaves*, the form of the *bunch*, and that of the *berries*, this variety is similar to the Black Frontignan, and its rich muscat flavour is also much the same; the only material difference is in the shade of colour. Some consider the Red Frontignan different, but we think the supposed difference arises from the Grizzly becoming, under some circumstances, more red than usual; or from the Black

Frontignan colouring only red instead of black, as is sometimes the case with the Black Hamburg. Introduced by Sir William Temple, about 200 years ago. The Black, the White, and the Grizzly Frontignans require the same treatment. The portion of border where their roots extend should be protected from being invaded by those of other kinds of vines.

CLASS III.—WHITE GRAPES.

18. ROYAL MUSCADINE—syn. Common Muscadine. Amber Muscadine, Chasselas, White Chasselas, Chasselas Doré, Chasselas de Fontainebleau, D'Arbois, Pearl of some, Raisin de Champagne, Amiens.—*Leaves* with moderately deep lobes, smooth above and almost so beneath, the under side thickly reticulated. *Bunch* middle-sized, tapering, occasionally somewhat shouldered. *Berries* of medium size, round; skin thin, white, when well ripened assuming an amber tint; flesh tender, rich, and sugary. A good bearer, and sets well. One of the best white grapes in cultivation for the open wall, green-house, and early forcing in vineries or in pots. The berries are not so large as those of the White Sweetwater, but they set better; they also hang longer after being ripe, a desirable property, more especially when there is only one vinery.

19. PITMASTON WHITE CLUSTER.—*Leaves* with deep incisions, smooth above and rather glossy beneath, the ribs slightly hairy; foot-stalks smooth, tinged with red. *Bunch* scarcely so large as that of the Royal Muscadine, but more compact, shouldered. *Berries* round; skin white, acquiring an amber tinge; flesh tender, with a muscadine flavour. It ripens earlier than the Royal Muscadine, and is an excellent grape for the open wall. It was raised from a seed of the Black Cluster, by John Williams, Esq., of Pitmaston, near Worcester.

20. WHITE SWEETWATER—syn. Stillward's Sweetwater, Dutch Sweetwater, Water Zoete Blanc, Parel Druyf, Perle Blanche, Chasselas Précoce, Chasselas Royale.—Wood short-jointed. *Leaves* glossy and deep green above, pubescent beneath, reddish brown when first beginning to unfold. *Bunch* large, open. *Berries* large, round, white, sometimes a little brownish next the sun; flesh aqueous, sweet, and rich. One of the earliest of grapes, and deserving of cultivation, for owing to the large size of the berries it has a noble appearance. It has, however, the fault of setting imperfectly, especially when the vine is old, the bunches then having frequently an irregular, ragged appearance, in consequence of being composed of large perfect berries and small stoneless ones about the size of pease.

21. EARLY WHITE MALVASIA—syn. Grove End Sweetwater, White Melier, Melier Blanc, Mornain Blanc, Morna Chasselas, Blanc de Bonneuil, Grösserer Früher Malvasier, Früh Leipziger, Seiden Traube.—*Bunch* like that of the Royal Muscadine, but the *berries* scarcely so large; skin greenish white, thin; pulp sweet and tolerably rich. This sort is cultivated in many parts of Germany on account of its hardness and early ripening; and it is suitable for a wall in this country, but is not equal in quality to the Royal Muscadine.

22. REEVES' MUSCADINE.—*Bunch* large, broadly shouldered. *Berries* with short stiff pedicels, oval; skin yellowish white, rather thick; flesh melting, juicy, and rich. This variety, imported from the Cape by the late John Reeves, Esq., is a very abundant bearer, and therefore a few plants may be introduced in a collection.

23. CALABRIAN RAISIN—syn. Raisin de Calabre.—*Leaves*

not deeply lobed, smooth above and below; the ribs are even glabrous, instead of being furnished with short bristly hairs, as those of most varieties are. *Bunch* very long. *Berries* round, white, thinly covered with a delicate bloom, transparent, so that the seeds can be seen; flesh firm, sweet, and pleasant, though not rich. The bunch has a very handsome appearance, and contrasts well, as regards colour, with the Black St. Peter's, and a plant of it may be grown chiefly on that account. By having the two, black and white grapes in all their freshness can be insured for adding to the elegance of the dessert at a late period of the season.

24. **WHITE MUSCAT OF ALEXANDRIA**—syn. White Muscat, White Tokay of some, Tottenham Park Muscat, White Muscat of Jerusalem, Lunel, White Muscat of Lunel, Malaga, Muscat Eschcolata, Alexandrian Frontignan, Zebibo of Sicily, Passe Musquée Blanche, Passe-longue Musquée.—*Leaves* large, deeply lobed, sharply serrated, smooth above, slightly pubescent beneath; petioles long, smooth, stained with red, as are also the ribs for some distance from them. *Bunch* very large, strongly shouldered. *Berries* large, oval, hanging loosely; skin rather thick, of a pale amber colour; flesh firm, with an exceedingly rich muscat flavour. The remark made with reference to this grape in Lindley's *Guide to the Orchard and Kitchen Garden*, is most appropriate;—

"This may be justly considered as one of the very best grapes ever introduced into this country. It requires a higher degree of temperature to ripen than many others, and generally succeeds best in the pine stove. It may, nevertheless, be ripened very well in a lower temperature; but then it is necessary it should be forced early in spring." We have seen it forced in pots in a stove heat till nearly full-grown, and it then ripened off very well in a green-house, into which it was introduced in June.

25. **CHARLESWORTH TOKAY**.—This was considered different from the Muscat of Alexandria, but when grown side by side, no obvious distinction could be observed.

26. **BOWOOD MUSCAT**.—*Bunch* large, shouldered. *Berries* very large, oval or obovate, deep amber when fully ripened; flesh firm, juicy, with a rich, sugary, muscat flavour. It requires nearly the same amount of heat as the Muscat of Alexandria, compared with which it is rather earlier; but it keeps equally well, and is an abundant bearer and free setter. The variety was raised by Mr. Spencer, at Bowood, from the Cannon Hall and Muscat of Alexandria.

27. **STOCKWOOD GOLDEN HAMBURG**.—*Bunch* large. *Berries* approaching the size of the Hamburg, round, amber-coloured; flesh moderately firm, with a vinous, refreshing juice. It ripens along with the Black Hamburg, with which, as regards colour, it makes a good contrast. Described in the *Florist and Fruitist*, 1856, p. 33, as having been raised by Mr. Busby at Stockwood Park, from the Black Hamburg, fertilized with the Dutch Sweetwater.

28. **WHITE NICE**.—*Bunch* very large and loose. *Berries* middle-sized, somewhat oval; skin rather thin, greenish white; pulp tolerably soft and juicy, but not rich.

29. **SYRIAN**.—*Bunch* very large, with broad shoulders. *Berries* large, oval; skin thick, white; flesh firm, of tolerable flavour when well ripened with strong heat. From the firmness of the flesh, the bunches will long hang without decaying. Grown by Mr. Speechly at Welbeck, in 1781, to the weight of 19½ lbs. The variety is not to be recommended for a limited selection, and in the largest one plant is enough.

30. **CANNON HALL MUSCAT**.—This variety has thicker shoots and larger berries than the White Muscat of Alex-

andria; but when the latter is grown in rich borders, it is difficult to tell the difference. In point of flavour, however, the Cannon Hall is rather the inferior, and that being the case, we cannot recommend its cultivation in limited selections; and where there is a house appropriated to Muscats, one plant of this variety will be sufficient.

31. **CHASSELAS MUSQUÉ**—syn. Josling's St. Alhan's.—*Leaves* middle-sized, roundish, somewhat convex, not deeply lobed, the serratures turned downwards, of a bluish green colour, smooth above and nearly so beneath; petioles about 6 inches in length, moderately strong. *Bunch* tapering, rather loose, with large or small shoulders, or with none. *Berries* middle-sized, round; skin moderately thick, apt to crack, white, acquiring a yellowish tinge when well-ripened; flesh firm, with a rich, sugary, delicious muscat flavour. An excellent bearer, ripening early. Its only fault is that the berries are apt to crack; but various cultivators produce fruit without this defect; and by avoiding vicissitudes of moisture, either at root or top, it may be obtained in good perfection. Its flavour is thought equal to that of the White Muscat of Alexandria, and it will ripen well with much less heat. Moreover, from ripening earlier, it will save the Muscats from being cut too soon, as is frequently the case, by those who prefer the muscat flavour.

32. **WHITE FRONTIGNAN**—syn. White Constantia, Nepean's Constantia, Muscat Blanc, Raisin de Frontignan, Muscat Blanc de Jura, Moscatel Commun, Muscateller, Weisser Muscateller, Weissgelber Muscateller, Weisse Muscaten Traube, Schmekende, Weyrer, Muscatály, Moschata Bianca, Moscat Bianco, Moscado Bianco, Moscatello Bianco, Moscatel Menudo Blanco, Moscatel Morisco, Muscat Beli, Bela Dinka, Zoruna.—*Leaves* roundish, open at the base, not deeply (sometimes scarcely) lobed, but having deep serratures; midrib not bristly. *Bunches* long, conical. *Berries* middle-sized, round; skin white; flesh somewhat firmer than that of the Royal Muscadine, and possessing a delicious, rich, muscat flavour. In the south of England this will, in some seasons, ripen to good perfection on the open wall.

Grapes for an open wall in the southern parts of the kingdom.

Royal Muscadine.

Pitmaston White Cluster.

For an early vinery.

Black Hamburg.

Royal Muscadine.

Black Prince.

White Sweetwater.

Chasselas Musqué.

For a late vinery.

Black St. Peter's.

Lady Downe's Seedling.

Calabrian Raisin.

Trentham Black.

Black Barbarossa.

For a green-house.

Black Hamburg.

Chasselas Musqué.

Royal Muscadine.

Black Prince.

For a stove.

Muscat of Alexandria.

Bowood Muscat.

Black Barbarossa.

Muscat Hamburg.

Propagation.—This is effected by seeds, cuttings, layers, and graftings.

Propagation by seeds is chiefly with the view of obtaining new varieties. The object of doing so in this country should be chiefly

that of obtaining hardy sorts for green-house culture, and for the open wall, in favourable situations. That there is a very great difference in the hardness of grapes will be readily admitted, for we have only to call to mind the appearance of a Muscat of Alexandria, and that of a Black Cluster, both grown in the open air; in the one a great proportion of the shoot is green and immature when growth is arrested in autumn; in the other the wood is mature, and comparatively hard, nearly to the very extremities of the shoots. Therefore it is probable that by crossing such sorts as the Black Hamburg, Royal Muscadine, Black Prince, White Frontignan, and Chasselas Musqué, with the Black Cluster, varieties as hardy as the latter, with larger bunches, and berries of better quality for the dessert might be obtained. It will be observed that the petals of the flowers of the vine are inflected at the top, and form a sort of cap inclosing the stamens and pistil. When the vine is in good condition, and in a suitable temperature, this cap is thrown off, and the anthers exposed to the influence of light and air; they then soon burst, and fertilization is effected. Before this takes place, when crossing is to be performed, the stamens should be cut away with very fine pointed scissors; and afterwards, when the style and stigma are sufficiently developed, the pollen of the hardier vine shaken on a piece of paper should be applied with a camel-hair pencil to the stigma of the sort to be fertilized. The process may also be reversed by fertilizing the hardy sort with the pollen of the sorts above mentioned, or that of others that may be thought eligible.

The seeds should be sown early in February, in pots or pans of light rich loam, mixed with a little leaf-mould. The pots should be kept in bottom-heat, and always near the light during the growing season, shifting when necessary. With plenty of heat, both at top and bottom, light, and air, the plants will probably bear in three or four years; but in the second year some may be inarched or grafted on bearing vines, and thus strong shoots may be sooner obtained than would be the case from the seedling plant.

Cuttings.—Where the soil is warm a well-ripened vine shoot inserted in the ground will strike root; but in this climate the progress of rooting is too slow for a good shoot being formed before cold weather sets in. With bottom-heat the rooting process is accelerated,

but it is found, notwithstanding, that when a strong young shoot is produced with plenty of air and sufficient moisture, the returning sap is checked considerably when it comes to the old wood, and we frequently see that the young shoot becomes, in consequence, thicker than the old wood intervening between it and the roots. This thickening does not indicate a natural condition, for the increase in the diameter of the young shoot arises from an accumulation of sap, which, if there had been no interruption, would have gone to make roots. Such being the case, it is found best in propagating the vine to dispense, as much as possible, with old wood. Accordingly, plants raised from single eyes or buds are preferred, for experience has proved them to be the best. A bud with about half an inch of shoot on each side is all that is necessary; indeed, some slice off half the shoot, or more, opposite the bud.

The shoots from which eyes or buds are to be taken for propagation should be firm and well ripened. We have seen vine shoots from Malaga so well matured that they cut almost as firm as a piece of old vine wood. They were cut into single eyes, and subjected to precisely the same treatment as eyes from the best-ripened shoots, whether from the open wall or vinery, in this country; but the strongest plants were produced by the Malaga shoots. The eyes should be planted in the end of January; if earlier, the plants would not have light enough; later, they would have a shorter period for growth. When prepared, the eyes should be planted singly in small pots filled with rich compost of good friable loam, leaf mould, and a little sand. They ought then to be kept in moderate heat for a week, afterwards plunged in a bottom-heat of about 75°; and when the plants have made several leaves the bottom-heat may be increased to 85°, the top-heat averaging about the same during the day, or higher with sun and air, and 75° at night. As soon as the roots have reached the sides of the pots the plants should be shifted, and this operation should be repeated as often as the growth of the roots may render it necessary. Only, towards the end of the season, the pot may be allowed to get rather full of roots, but not so much as to prevent their being spread out with facility, and without entanglement, on planting out. By giving top and bottom heat, with plenty of air and light, as well as occasional waterings with

clear liquid-manure water, strong well-rooted plants, with firm wood, will be insured by the end of the season, much superior to those raised by long cuttings, coiling, or layering, which therefore need only be briefly noticed.

Cuttings consisting of two joints may be employed; they should be cut closely beneath the lower eye, inserted in pots filled with rich soil, so that the upper eye may be scarcely covered. Their growth should then be promoted as directed for the rearing of plants from single eyes.

Coiling a shoot, 5 or 6 feet long, in a pot, and leaving only an eye or two above the surface, was supposed advantageous, on account of the great store of organized matter such a shoot must contain, as compared with a short one, or more especially with that in the small portion attached to a single eye. Now, the elaborated sap which a certain amount of foliage can return to the portion of the plant below ground will be much the same whether that portion consists of a large quantity of old shoot, with some pushing fibres, or almost entirely of young roots. In the former case, supposing the coiled shoot to be 5 feet in length, and only $\frac{3}{4}$ inch in diameter, a surface of more than 120 square inches would have to receive the share of returning sap which would be due to that extent of surface, and then it is certain there could not be much left for the formation of spongioles and young roots. The organized matter stored up in the matured wood of the old shoot may be drawn upon by the leaves in the first instance, but the same shoots will repay themselves with interest as soon as the leaves begin to elaborate and return sap. On the whole, therefore, no advantage can be derived from long coiled shoots, but the contrary.

When it is desirable to propagate any sort as extensively and as quickly as possible, all superfluous young shoots may be slipped off when 6 or 8 inches long, and put under propagating glasses; and well-rooted good plants may thus be obtained, free from any old wood.

Layering.—By this mode it was formerly usual to propagate in the open ground, and strong plants were produced by the end of the season. It is the best mode where fire-heat is not at command; but the objection of too much old wood applies to it. The author of the *Guide to the Orchard and Kitchen Garden* recommends the operation to be com-

menced as soon as the leaves have fallen, and to use 8 or 9 inch pots, sunk 2 inches below the surface, and three-parts filled with good mould, twisting the shoot till it splits, and then, layering it in the pot, shorten it to two eyes. "In the spring, when they have grown 9 or 12 inches, they should be staked, tying the two shoots of each layer to the stake, cutting off all the other shoots which are produced upon the bender between the stole and the pot. When the shoots have attained the height of 2 or 3 feet, the uppermost shoot must be cut off, leaving the lower one only, training it up from time to time till it reaches the top of the stake, which need not be more than 6 feet at the most, when it must be stopped."—(*Lindley's Guide to the Orchard and Kitchen Garden*, p. 220.)

By leaving two shoots, as above directed, plants with roots more in proportion to the tops will doubtless be obtained; for whilst the temporary shoot is growing, it will be at the same time contributing to the formation of roots, which will then bear a greater proportion to the shoot left, than if only one had been allowed to grow.

The vine may also be propagated by either of the various modes detailed under the head of layering, in the chapter on propagation. The young shoots may be introduced in baskets filled with friable turfy soil, and when sufficiently rooted they may be gradually detached from the parent vine. By this mode they can be carried to a distance more safely, and at less expense than if they were in pots.

Grafting.—The grafting of vines is easily and successfully accomplished, provided the operation is performed when the stock and scion are in a fit state. When vegetation is inactive, of course no vital union can take place; and, on the other hand, if the vine is wounded when the sap is rising, and before the leaves expand, bleeding ensues. Having, at the time of pruning, selected scions from the best-matured shoots of the kind which it is intended to propagate, let their ends be inserted in moist earth, or in moist sand in pots, which is preferable, as they can be moved into a warmer temperature some time previous to grafting. Before there is any danger of bleeding, the stock or branch intended to be worked should be cut back to where the graft is to be put on. This may be, according to circumstances, either on the last year's shoot, or on the older wood. Select a place where the

scion can be put on as in whip-grafting; but if the shoot is inclined, the scion should not be placed on the under side. Then cut back the stock or shoot above a bud opposite to where the scion is to be put on. When the buds of the vine to be grafted begin to expand, let the scions be brought into a temperature approaching to that in which the stock is growing, so that they may be prepared to start the sooner after grafting. When the bud to which the shoot or branch was cut back has pushed 4 or 5 inches, pinch it back to two leaves, and whip-graft on the opposite side. In tying and claying, the bud of the scion must be left free to push; and after claying, the whole should be mossed over; still, however, leaving the buds exposed to light; it is also necessary that the moss should be kept moist by frequent watering and syringing with tepid water. When the scion has burst, one of the two leaves on the shoot left opposite to it should be cut off; and as soon as the buds of the scion have fairly expanded into leaf, it will be in a condition to appropriate all the sap; and that being the case, the whole of the shoot which is left may be removed. The shoot from the graft ought to be allowed full freedom of growth to produce as much foliage as can possibly be well exposed to light; but if it should attain the height of 12 or 15 feet, it may be stopped. Various other modes of grafting may be employed, but we have found whip-grafting the best; it makes a much sounder union than cleft-grafting, which many recommend, because, by adopting that mode, they have obtained long shoots in the same season. Of this we are aware; but at the same time the cleft portion will never become sound.

Out-door Culture.—Glass being cheap, there is greater inducement to have grapes under its shelter now than formerly, and less to attempt their ripening on walls, or in the open ground. Nevertheless, we still see thousands of cottages having their front walls or gables covered with vines; and in warm seasons properly selected sorts under good management may be ripened very well.

Soil.—Provided the situation is warm, the leaves freely exposed to light and air, and the roots supplied with a moderate quantity of moisture, the vine will grow in almost any soil. We have seen it succeed both in strong deep loam, and in rocky ground thinly covered with poor sandy soil. In the open air, or

against a wall, vines will thrive in any well-conditioned soil that is suitable for fruit-trees generally. A rich, mellow loam, always pervious to moisture, will suit the vine in the open air, and it should be refreshed occasionally with a dressing of compost consisting of maiden loam and dung; if the loam employed for this purpose is turfy, so much the better. In gravelly soil mixed with peat the roots of the vine are not liable to perish from moisture in winter; and having roots fit for action, the plants are prepared to make an earlier growth than those that have nearly all their smaller fibres either destroyed or in bad condition.

Planting.—The best season for planting vines against walls or elsewhere in the open ground is in the month of October, early in November, or in spring, just before the sap begins to rise. The roots should be carefully spread out and covered with rich turfy loam, made rather fine; then moderately watered, and afterwards mulched.

The cultivation of the grape on open walls is perhaps nowhere so carefully attended to as at the village of Thomery, on the banks of the Seine, about five miles from Fontainebleau, and from this neighbourhood Paris is supplied with 30,000 lbs. of grapes daily during the grape season. We shall therefore briefly state the mode of culture which the industrious inhabitants of that village have from long experience adopted. The soil is a light brown sandy loam; a sample of it analyzed by Professor Solly, gave 81 per cent. of silica, 7 of alumina, and only $3\frac{1}{2}$ of organic matter, therefore it had not been highly manured; yet from such soil the Royal Muscadine or Chasselas de Fontainebleau grape is produced of excellent quality. The bunches we saw were only middle-sized, as were also the berries; but these had acquired a fine yellow tinge indicative of perfect maturity, and the quality was excellent. Doubtless this is in a great measure owing to the climate; but much is due to the system of management. The principal feature in this is that each plant is trained with only two branches extending horizontally, as nearly as possible from the same point, one to the right and the other to the left; and from these the bearing shoots are trained upright. The distance between the horizontal courses is 18 inches. At Fontainebleau we observed that the plants were 3 feet apart, and the distance between

the courses of horizontals was 2 feet, and these distances are preferable in our soil and climate, in which the vine makes longer shoots than at Thomery. The length of the two horizontals of each vine is equal to the distance at which the vines are planted, multiplied by the number of horizontal courses which the height of the wall will admit; or the length of each horizontal is equal to half that product. A wall 12 feet high will thus admit of five courses; and, planted 3 feet apart, each plant will extend its horizontals 15 feet, or $7\frac{1}{2}$ feet on each side, crossing the adjacent upright naked stems. A bearing shoot is allowed to spring from each eye; it is trained upright, and stopped when it reaches the next horizontal; if laterals push, as is likely to be the case in consequence of the stopping, they are cut off above the second leaf. At the winter pruning all the upright shoots are cut back to the lowest two eyes. On the upper one of these the fruit is chiefly borne; but it is completely cut away at the ensuing winter pruning, whilst the other shoot is cut down to its lowest two eyes. If more than two shoots push from the bases of the shoots cut back, they are pinched off close as soon as they can be well laid hold of. The horizontals extend equally on both sides of the stems, and are allowed to meet, but not pass each other.

By the Thomery mode, according to the *Bon Jardinier*, as many as 320 bunches can be produced on a surface of little more than 8 feet square. In this calculation it is supposed that each horizontal of 4 feet 4 inches in length will support eight upright shoots with two bunches on each; but in this climate the shoots would require more space; and besides, the wall, in order that it may be heated by the sun, should not be completely covered with foliage; therefore only half of the above quantity should here be reckoned on for the same space.

It will be observed, that in this mode of training, the flow of sap in each plant is divided among sixteen shoots, all of which are equal as regards origin and position. They all spring from a horizontal base, they are equally upright, and all are stopped when they attain a certain height, and each should have the same amount of foliage. The stopping takes place in the early part of the season, and in consequence of this the bud at the base of the part left gets well matured. Considering the limited development which each plant

is allowed to take, the quantity of foliage is in ample proportion, and year after year it is almost uniformly the same; consequently, the elaborated sap supplied for the support of the roots is as regular as is the demand on these for support in return. Such is not the case when vines are trained in a rambling manner and without system; for in that case the roots are perhaps to-day in full communication with the large amount of foliage on a number of long shoots, and to-morrow all these may probably be cut away without considering that the roots must suffer severely from the shock; the portion of foliage left being frequently less than that suddenly removed. It is not so with the Thomery system, in which the shoots have only their points taken off in a young state, rendering the removal of perfect foliage for the most part unnecessary. From these considerations, and from what we have observed of the system abroad, as well as the favourable results which have, in some instances, been obtained in England by adopting it, we think that the Thomery system is the best that can be pursued in our climate, allowing, however, a distance of 3 feet between the plants, and 2 feet between the horizontal courses.

Should it be found that after a fair trial the above mode does not succeed, in consequence of the dampness of the climate and soil, then the following may be adopted. Horizontal branches should be formed to the right and left, and from these upright shoots ought to be allowed to push at 1 foot apart, stopping them in summer when they have attained a height of from 4 to 6 feet, according to their strength. At the winter pruning every alternate upright should be cut down to the lowest two eyes; and those not so cut back may be shortened to 2 feet if rather weak, but to 3 or 4 feet if strong and well matured. These are to bear the fruit in the following summer. The best of the shoots from the two eyes to which the other shoots were cut back, should be allowed to grow from 4 to 6 feet, and then be stopped. They ought to be shortened at the winter pruning to between 3 and 5 feet according to their strength; and those that have borne fruit should be in their turn cut down to two eyes. Thus, with the exception of the horizontal branches, there is no two-years' old wood, the uprights consisting of the current and previous summer's shoots; the former are short-

ened at the winter pruning for bearing; the latter cut back to within two eyes of the base. In this way the wall can only be covered to the height of 4 or 5 feet; for the upper part, vines would require to be planted, and carried upright with a single stem 5 or 6 feet high, above which a second series of horizontals and uprights should be formed, and managed precisely as in the lower series.

Culture under Glass.—Grown in the open air, grapes generally colour well even if they should not ripen; and the leaves are robust in appearance, thick and leathery to the feel. It is not always so with the foliage of vines subjected to more artificial treatment under glass; for there, forced into too rapid development by heat and moisture, without a corresponding amount of light, the leaves are sometimes very broad, but comparatively weak and thin. We have observed, that even in this country, vines growing in the open air maintain their roots in a sound state for many years in any soil that is not excessively bad; but by artificial treatment under glass, the foliage of the vine is in many instances rendered incapable of invigorating the roots, and these, consequently, are liable to become weak, and even to perish. This being the case, great care is necessary in the formation of the border and in the selection of the materials of which it is composed.

The front wall of a vinery should be carried up high enough to admit of the surface of the border being raised 18 inches or 2 feet above the general level of the adjoining ground; indeed, 3 feet may be allowed if a terrace can be formed; and if so, the vines will have less damp and more light than if the base of the vinery had been kept low. It is therefore desirable that with reference to the adjoining ground the vinery should occupy an elevated site.

Depth of Border.—The vine is very successfully cultivated in deep loam on the banks of the Douro, and so it is in shallow soils among rocks on many parts of the Continent. In this country we hear of its succeeding well in deep, and likewise in shallow borders. In order, however, to support heavy crops for a series of years, a large quantity of nutritive substances is necessary; and a greater depth of soil is requisite to nourish a Black Hamburg, for instance, extending over a large surface, than a Burgundy, pruned so as to be not larger than a raspberry plant.

Before proceeding to excavate for the border, the surface level at the front wall should be determined, and, as we have recommended, with reference to that of the adjoining ground. It will then serve as a datum from which the depth of the border can be measured. A depth of 3 feet of prepared soil we consider proper; it is not too much, provided it is laid on a well-drained subsoil, for in that case the earth, at 3 feet deep, is, on the average, as warm as at 1 foot deep. In a border of that depth vines have long continued to produce good crops. Then, 3 feet below the datum line or surface of the soil at the front wall, will be the bottom of the prepared compost; and another 9 inches should be excavated for drainage, making the total depth to be excavated 3 feet 9 inches. The soil thrown out would be very appropriately employed in raising a terrace, on which a walk with grass verges could be formed in front of the border.

Drainage.—In some situations holes may be dug to the depth of 4 feet or more without water from below collecting in them at any time of the year; but in others, at that depth, water will rise at almost any season, and especially towards the beginning of summer, when the springs are generally at their highest. In the former case, draining is not essential; but in the latter it is of the first importance. If water is constantly percolating from springs on the north side, it will render the bottom of the border cold and chilling for the roots; and as in this case a drain in front will not be sufficient, one lower than the bottom of the border should surround the site of the vinery.

Bottoming the Border.—The drainage materials should be laid in the bottom of the border to the depth of 9 inches at least, and with a slope to the front drain. They may consist of brick-bats, lime-rubbish, old plaster, stones broken like road-metal, &c., but of all others we consider chalk rammed hard to be the best. In many districts it may be had close at hand; and in any place it can now be cheaply obtained by railway. The roots do not penetrate through the rammed chalk, and this substance, whilst it retains a certain amount of moisture, is yet sufficiently porous to drain off that which is superfluous. Some recommend the bottom to be paved, but paving flags next the warm soil will always be wet by condensation if their under sides are cold by contact with a subsoil in the proximity of spring water. Vines will therefore thrive

better on chalk than on stone, or even loose drainage, through which the roots will occasionally push into cold bad subsoils.

The width of the border need not be more than 4 or 5 feet at first; but after two years another breadth of 5 feet should be added, and as the roots extend the width may be increased to 15 feet, which will be quite enough.

The level of the surface and bottom of the border having been determined, as well as its width, we may now proceed to the consideration of the kind of soil to be introduced, and its preparation.

Soil.—In order to produce heavy crops the soil must be rich; and to prevent the roots from perishing from cold and humidity, it should be composed of open materials not liable to become a spongy, saturated mass. A rich turfy loam is the best main constituent of a vine border; and the fibre of the turf should be of a nature that it will not readily become quite rotten. Independent of its fibre, the loam itself should be naturally at all times pervious to water. If loam intended for vine borders were brought in contact with stable manure in a state of fermentation it would absorb ammonia, and vines planted in it would be in a condition to make a good start and produce healthy and vigorous foliage. In order to dispose the loam for the absorption of the ammonia, it may be laid in alternate layers about 18 inches thick with fresh fermenting stable dung, the litter of which should be previously well soaked in urine from the stable, mixed with water. Another mode of attaining the same object would be to build the loam in beds 3 feet wide and 4 or 5 feet high, with 2-foot spaces between, and holes having been bored horizontally through the beds, to fill up the intermediate spaces with fresh stable manure, covering it with a few inches of soil to prevent the escape of ammonia at top. The dung may remain till its fermentation has considerably abated, when it may be removed and the loam turned over without being much chopped; and if naturally rich, may then be considered fit for putting in the border, but otherwise some rich well-prepared compost should be mixed with it. Such compost may consist of loam, a little turfy peat, old plaster, and half-inch bones. The mass should be turned several times, and on each occasion a little fresh loam mixed with it in order that the gases arising from fermentation may be completely absorbed. A rich

compost thus worked up will prove better adapted for mixing with the soil of the border than strong manures, which have not been subjected to any such preparatory process. A very good compost for enriching the loam for a border may be formed of two parts of turfy loam and one of pigs' dung, mixed with the loam at the rate of one load in ten. Turfy loam thrown into sheep-pens is soon rendered an excellent soil for a vine border, without the addition of any other ingredients.

Planting.—In vineries planting may be performed at any time if the plants are in pots, but if they have previously been growing in heat the operation should be deferred till the border is quite as warm as the mean temperature of the place whence the vines have been taken. The plants should have length enough to pass through the opening prepared for them in the front wall, and reach several feet up the trellis in the inside. The general mode has been to introduce the vines through a hole in the front wall 1 foot or more above the surface of the border; but it is much better to pass them through 6 inches below the surface, so that no portion of the stem may be exposed outside. A hole should be taken out for the ball, and from that a groove for the shoot towards the front wall. The upper roots should not be less than 6 inches below the surface, and the shoot inclining upwards not less than 4 inches below the ground level, at the point where it enters the opening in the front wall; inside, the shoot ought to be trained in a direction parallel to, and as near the glass as possible, without the leaves touching it.

Temperature.—We have the excellent authority of Sir William Hooker in stating that the favourite climate of the vine in the Old World is between latitudes 36° and 48°; but it thrives wherever the mean temperature is from 62° to 47½°, provided that of winter is not below 33° nor that of summer under 66° or 68°. Such is the ease on the shores of Europe up to latitude 47°, and in the interior of continents to latitude 50°. Certain varieties are adapted for the high temperature which prevails in the extreme south of Europe and north of Africa; others succeed in certain localities as far as latitude 50°. If even the hardiest varieties occasionally succeed beyond this, it must be under peculiarly favourable circumstances. The range of the vine in Europe may therefore be reckoned at about 1000 miles from south to north. But long before

reaching the northern limits the cultivation of our most esteemed hot-house grapes must give place to smaller and hardier varieties, such kinds as the Muscat of Alexandria being only adapted for a high temperature, such as prevails in the hottest parts of Europe. There they succeed admirably, and that being the case, it may fairly be concluded that the climate must be highly favourable, and proper for imitation by artificial means.

The following table exhibits the mean temperature of the air (omitting fractions) from January, when the buds are in a comparatively dormant state, till September, at Beyrout in Syria, lat. 33° 50' N.; Cadiz, lat. 36° 32' N.; and at Catania, in Sicily, lat. 37° 30' N., where grapes attain a high degree of perfection in the open air:—

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.
Beyrout, . .	56°	59°	61°	63°	69°	75°	81°	81°	80°
Cadiz, . . .	51	53	55	59	63	68	70	72	70
Catania, . .	49	54	56	61	71	79	86	88	78
Average,	52	55	57	61	67	74	79	80	76

By the examples above selected it will be observed that in the principal growing and ripening months, May, June, July, and August, the climate of Catania is the hottest, and its temperature is probably as high as vines that are being forced could well bear. Nevertheless, with care, it may be safely followed in the case of Muscats, and other large sorts; and here it may be remarked that the Muscat of Alexandria, under the name of Zebibo, is one of the sorts grown in Sicily. The temperature of Beyrout is to be preferred when a very early crop is not the principal object.

The following table is drawn up from a diary of vine forcing kept, where bunches of Black Hamburg were grown to 8 lbs. weight each, at Oak Hill, East Barnet, by Mr. Forsyth, and published in the *Gardener's Magazine*. From the data there given we have arranged the temperatures in weekly order from the commencement of the process, when the vines are dormant, till the ripening period, contrasting it with the average weekly temperature of Beyrout, Cadiz, and Catania. The weekly temperatures given for these places are, however, only approximations, yet they must be very near to the truth from their having been obtained by drawing lines proportionate in height to the monthly temperatures, and raising others at one-fourth, one-half, and three-

fourths the distance between every two. The lengths of the intermediate ordinates in this and similar cases represent the intermediate average weekly temperatures to within a fraction of a degree, which is certainly near enough for practical purposes. The temperatures thus obtained coincide, it will be observed, with those afforded at Oak Hill, or differ but slightly from them. For the first four weeks after the application of fire-heat at Oak Hill, the weekly temperatures correspond with the average of those of the places abroad between the third week of April and middle of May, when vines out of doors naturally push; and at Oak Hill, artificially, shoots were produced in the same temperature:—

Week.	Temperature at Oak Hill.			Weekly mean of Beyrout, Cadiz, and Catania.	REMARKS.
	Max.	Min.	Mean.		
1	60°	45°	52°	57°	Vinery shut up, Nov. 8.
2	60	45	52	58	
3	60	50	55	59	
4	65	55	60	61	Fire-heat applied, Dec. 1.
5	69	57	63	63	
6	70	58	64	64	
7	72	59	65	65	Buds swelling, Dec. 22.
8	74	61	67	67	Heat of dung on border 96°
9	76	63	69	68	
10	78	65	71	70	Shoots 2 inches long.
11	81	68	74	72	
12	83	71	77	74	
13	84	73	78	75	{ Vines in flower generally, Feb. 15.
14	85	75	80	76	
15	85	76	80	78	
16	85	76	80	79	
17	85	74	79	79	Berries all set.
18	85	72	78	79	
19	85	72	78	79	Berries thinned.
20	85	72	78	80	
21	85	72	78	80	
22	85	72	78	80	Black Hamburg colouring.
23	83	72	77	79	
24	83	72	77	79	Sweetwater ripe.
25	83	72	77	79	
26	81	70	75	79	

Ventilation.—At all times when the state of the weather will permit air should be given, but with due caution, especially when there is great disparity between the internal and external temperatures. Air ought never to be given with the view of lowering the temperature, but to prevent the latter from getting too high. Even if giving air should be neglected, and the house be found too hot, air ought to be given to prevent any further rise, but not to cause a sudden reduction of temperature.

Watering and Syringing.—Heat, air, and moisture should be so regulated as to produce a uniformly progressive growth of foliage, for

on this depends not only the excellence of the present but also that of the future crops. It is, on the contrary, injurious to supply heat and moisture to such an excess as to cause a too rapid elongation of shoots and expansion of foliage. Such is the case when the development in a given time is greater than occurs under the most favourable circumstances out of doors. Whilst, therefore, sufficient moisture should be supplied, its excess must be guarded against. When the shoots are seen becoming unusually long-jointed, and the foliage broad but thin, it is necessary to see that the temperature is not too high; if so, it must be gradually lowered to that which is proper, and by so doing excessive development will be moderated. But, notwithstanding this, if moisture is constantly in excess, the atmosphere of the house being kept continually in a saturated condition, so that the leaves cannot perspire, they will not properly elaborate the sap. During some period of the twenty-four hours the air should not be fully saturated with moisture; and this period ought, if possible, to be in the day-time, so that the process of evaporation may take place when the foliage is under the influence of light. But here we must observe, that the atmosphere of vineries and other forcing houses is generally rendered too dry by the coldness of the glass acting as a condenser of the moisture contained in the warmer air of the house, thus rendering it dry in the night when the vine growing naturally out of doors enjoys a moist atmosphere. The greater the difference between the temperature of the air and that of the glass, the drier the air becomes. Therefore, by reducing the coldness of the glass by means of some warm covering, the drying process would be greatly counteracted.

The house may be steamed by pouring water on the flues, and moisture may also be derived from damp soil and watering the paths, &c. But, notwithstanding all these means, the leaves of the vine will frequently be exposed to the action of dry air towards morning, before they can be moistened by syringing, in imitation of a shower. Before rain the external air generally becomes moist by degrees; and so, previous to syringing it, would be well to raise a little steam, in order that the leaves when in a too dry atmosphere may not be suddenly drenched.

The vines being early freed from the effects of night dryness, a moist atmosphere may be

permitted till the moisture be gradually dissipated by the sun's rays and ventilation. When, in the afternoon, the heat of the day begins to decline, a reduction of the ventilation should be commenced.

Pruning and Training.—The mode of bearing in the vine is very different from that of many other kinds of fruit-trees. In the peach, for example, no fruit is borne on the young shoots of the current year, but on these blossom-buds are formed for fruiting in the following season; and it can be perceived in winter where fruit will be situated in the summer, provided no accident occur. Such is not the case with the vine; a shoot may push from an unseen latent eye in the old wood, and on this shoot as it grows, whilst young and tender, the rudiments of a bunch may be seen; and frequently, as the same shoot proceeds in growth, a second bunch, or even more, will sometimes be formed. A young shoot may this year grow to the length of 15 or 20 feet, and having been shortened to 10 or 12 feet by cutting off the more recently formed, and consequently least matured portion, an eye or bud will be found in the axil of every leaf on that which remains. Next season it is possible that on this shoot, or rod, as it is termed, every eye may develop a young shoot which will bear one or two bunches of grapes. Thus, any young shoot of a vine, whether proceeding from a bud on the last year's shoot, or from older wood, is eligible for bearing fruit. Therefore, whether we leave the last year's shoots long, or short, or cut them back to within a few eyes of their bases, or even to the lowest eye, still on the shoot or shoots which push, there may be fruit. It is necessary to bear in mind, that if the sap find plenty of eyes on young rods of the preceding season's growth it will not readily push latent eyes from old wood. Some principally depend on the last year's shoots for bearing the crop, leaving a few at considerable length for that purpose; others do the same, cutting them back, however, to shorter lengths and leaving more of them; whilst many adopt the system of cutting back all the last year's wood nearly close to the stem. Accordingly, there are three systems in use, termed the *long-rod*, the *short-rod*, and the *spur* systems, and there are various intermediate modifications of these. It must be admitted that good crops have been obtained for several years in succession by each of the above

methods; and that being the case, it is evident that productiveness does not absolutely depend on the adoption of any particular mode of training. Whatever this may be, the production of foliage, and its maintenance in an efficient state, should be the primary consideration. As regards the culture of the vine under glass, some that get credit for being good *fruit growers* are not in all cases good *leaf growers*. A person may obtain large crops of fruit for a few years if he have strong well-conditioned vines to commence with; but if the quantity of foliage he maintains be not equal to supply the roots with a due share of elaborated sap, a general weakness will ensue. Roots under certain circumstances will continue to grow for a time, although there may be no leaves on the plant; but the growth of roots cannot be long carried on independent of the leaves. If the foliage is scanty, the roots will be few; if unhealthy, the roots will soon become unhealthy too. The amount of foliage should be as much as can possibly be well exposed to light, of course more or less according to the surface of glass. So far then as regards the essential principle of maintaining the vine in a healthy vigorous state, that mode of pruning and training is the best which admits of the greatest amount of foliage being exposed to light. In order to turn the structure to the best account, as great an amount as possible of the light transmitted through the glass should act upon the foliage. We do not, of course, mean that the leaves should form a close green canopy under the glass through which no direct solar rays could penetrate, and below which all would be darkness; on the contrary, there ought to be numerous openings clear of foliage, so that the whole of the interior of the house may be light. Under one sash the leaves should not be crowded, whilst below others there are none. Whatever mode of training we may choose to adopt, these observations should be borne in mind; for, by acting in accordance with them, vines will be kept long in good health and bearing, instead of being ruined, as is frequently the case when, in training, the importance of the foliage is overlooked.

Long-rod System.—By this it is generally admitted that larger bunches are obtained than by the spur system; but for a greater weight of fruit under the same extent of glass the latter is preferred. In long-rod pruning the principle is to train a shoot of the last

year's growth for producing shoots to bear fruit in the current year, shortening it more or less according to its strength. From the buds formed on it last season, young shoots will push and bear fruit in the present. After bearing, this rod is cut away; thus all the two-years' old wood is dispensed with, provided it is not required to furnish the upper part of the house. As by this system the two-year old rods have to be cut away in the autumn, young shoots must be trained up during the summer, in order to be ready to replace them; and these, in their turn, are cut out in the autumn of the following season, and are then replaced by shoots of that summer's growth. Long-rod training in its simplest form is accomplished as follows:—

Plant the vine, train up one shoot, and when the leaves have fallen prune it back to the bottom of the rafter. In the next season train up only two of the best shoots, and when they have completed that season's growth cut one of them back to two eyes at the base. The shoot left at greatest length will likely bear some fruit; the other, cut back to two eyes, will produce two shoots. In autumn the one which bore the fruit should be cut out; one of the two young shoots, cut back according to its strength, will supply its place, and the other young shoot must be cut back to two eyes. "This mode of pruning and training is applicable principally to those houses where the rafters only are to be occupied by the vine, as over the pine pit, or where other crops are cultivated in the body of the house; but when it is intended to occupy the whole roof, this system may still be adopted, by extending the vine on each side of the rafter, till it meets that from the adjoining one; or, the vine may be divided at the bottom of the rafter, on its first training, and formed with two principals on each side, making four principals to each vine. If however, the vines should consist of the larger fruited class, such as Muscat of Alexandria, Black Hamburg, or Syrian, &c., one principal on the rafter, and one on each side will be much better than more. It may likewise be necessary to extend this system still further, where the house is large, and has a great length of rafter, which may be done by forming a second series one-half the way up the rafter."—(Lindley's *Guide*, p. 224.)

In carrying up a stem, to furnish shoots for the upper part of the house, that stem will be

naked between the parts where shoots proceed to furnish the lower part. To these naked portions of stem the young wood of the lower series may be closely trained, for naked wood does not require light.

Short-rod System.—Instead of training rods at considerable length for bearing, some prefer short rods, treating them on the same system of cutting out the shoots which have borne, and supplying their places with young shoots trained up for that purpose.

Mr. Roberts selects buds for the origin of spurs alternately on each side of a shoot which is allowed to progress to the top of the house, and he removes the other buds on each side, but so that those retained on one side may be situated about half-way between those left on the other. About two-thirds of the buds are thus removed; those retained being situated alternately on the right and left sides of the shoot. The operation of disbudding is performed when the wood is nearly mature, by cutting out the bud in the axil of the leaf, taking care not to injure the latter. The buds left push, and generally bear in the following season; in summer they are stopped one joint beyond the fruit, and in autumn are cut back to two eyes. These produce two shoots, one of which is allowed to bear fruit, and the other is not. At the autumn pruning the shoot which bore fruit is cut back to one eye at its base; the other is shortened to two, three, or four eyes, cutting above a bold prominent bud for fruiting, and those below are cut clean out, with the exception of one at the base, which is allowed to grow for succession, but not to bear fruit. There are left then, on the shortened shoot, only one bud at top to bear fruit, and one at the base for a succession shoot.

Spur System.—This is becoming the most general. The vines are usually planted so that one can be trained up each rafter; but some train them up the middle of the sash, and this we believe to be the preferable mode, because in spur training the shoots are cut back to buds close to the stem, and for the sake of the buds the leaves next the stem should be well exposed to light. Under the rafter the stem is partially shaded, whereas, in the middle of the sash, it is in the best position for the shoots proceeding from it being immediately acted upon by the light. A vine may therefore be introduced at that point, and trained in an upward direction; and care should be

taken that shoots are encouraged alternately, by removing two buds, and leaving one, or, in some cases, by retaining every other bud.

When the young shoots push let them be gently brought to a horizontal position, by bending them a little at a time, but so as not to break them. Frequently, opposite the fourth leaf, the rudiments of a bunch will be developed. The leaf directly opposite the bunch must always be preserved. Some stop the young shoot at one joint or leaf beyond the fruit, and some at two joints. It seems to be of little importance, as regards the swelling of the bunch, at which it is done, and hence, many good gardeners are not very particular as to whether they stop at one or two joints. Where there is plenty of room for the foliage to expand fully, we would say stop at two joints; for the sap elaborated by the additional leaf will go to strengthen the vine, and increase its roots. On the other hand, if stopping above the second leaf beyond the fruit would render the foliage crowded, then, by all means, stop at one leaf. After stopping, laterals will push; they may be stopped above their first or second joints.

Thinning.—This is sometimes necessary as regards the bunches; and in all cases the berries ought to be properly thinned out, and regulated. When more bunches are formed than the vine can bring to perfection, those which are superabundant should be reduced in an early stage of their growth, at all events, before they come into bloom. Sorts that produce large bunches should have fewer of them than those which naturally bear comparatively small bunches. The weight of fruit ought to correspond with the amount of good foliage; we have frequently seen it out of all proportion, in fact, so much so that there have been nearly as many bunches as leaves. Naturally the young shoots push a few leaves, then a bunch or a tendril appears, and this is always opposite a leaf. As the shoot proceeds other bunches may form at greater or less intervals, but still in the natural state the number of leaves far exceeds the number of bunches.

The thinning of the berries should also take place as soon as they are well set, which will be soon after blooming. The general form of the bunches of some sorts of grape is that of an inverted cone, of which the stalk is the axis; in others the main stalk subdivides and forms shoulders. At the upper part of the bunch

branchlets diverge from the axis, and often these again throw out stalks bearing frequently three berries, namely, two side ones, and one terminal. Towards the lower extremity of the bunch the foot-stalks of the individual berries proceed directly from the axis, which terminates in a single berry. In thinning, the berries which proceed directly from the axis should be first removed, then each ramification should be successively inspected, and the berries thinned out where they would otherwise be too thick, taking care to cut off those nearest the axis or central stalk. The reason of this is obvious, for if we cut off, say, two-thirds of the outmost berries, those left would still be crowded; but by reversing the process the berries occupy a wider space, just as a number of persons forming a small circle may be overcrowded, but by each withdrawing from the centre, all soon find plenty of room. In proceeding up the bunch, peduncles from the main axis, bearing three berries, as already mentioned, will be met with. Mr. Roberts recommends (*Culture of the Vine*, p. 52) the terminal one to be left, and the two side ones removed. Where there are shoulders, they should be thinned on the same principle, and also tied away from the main part of the bunch by slender pieces of matting. The thinning should be modified according to the varieties, and the space their berries require when full-grown; and in avoiding overcrowding, the berries should not be made too thin and straggling.

In thinning, the berries should not be touched either with head or hands that are perspiring; and as they increase in size, after the first thinning, the bunches should be looked over, and regulated by a second thinning when necessary.

Pot Culture.—The cultivation of vines in pots is not new, for it was practised by Speechly at Welbeck in the end of the last century, but chiefly with the view of proving varieties forming part of a collection too extensive for being all planted in the vineries. Recently, however, this mode of culture is found very advantageous in other respects, especially as regards a very early supply; for by it such can be obtained without forcing the permanent vines so much in winter, and consequently they are enabled to bear larger and finer crops for many years consecutively.

Plants for fruiting in pots should be raised from eyes, and grown as strong as possible in

rich turfy loam mixed with about one-third of horse-dung, and a little bone-dust. The temperature should be gradually increased from 60° to 80° or 90° by sun-heat, and a bottom-heat always a few degrees higher must be maintained. As the roots require more room, the plants ought to be shifted from 3-inch pots into those of 6, 9, 13, or 15 inches in diameter, and in either of the latter two sizes they may be fruited in the following season. As growth proceeds it should be determined how the plant is to be trained for fruiting in the ensuing season, whether upright, arched spirally, or umbrella-shaped; and then from what part of the shoot it would be desirable that buds to push shoots for fruiting next year should be situated. The lowest of these buds having been fixed upon, the leader ought to be stopped at five or six joints above it by pinching out the growing point. From the axil of the leaf, immediately below the point of stopping, a lateral will readily push, and a bud by its side in the same axil will not likely do so till next season if the lateral is allowed to grow; the latter should therefore be entirely removed as soon as it can be laid hold of. The bud will then start and take the lead, making a much stronger shoot than the lateral would have done. This stopping will concentrate the sap in the buds below, and tend to insure their breaking into fruitful shoots in the following season. When the new leader has formed buds as high as will be required for fruit shoots, it should be also stopped and the lateral displaced, so as to stimulate the latent bud to take the lead as before. It may be allowed to grow to the length of 7 feet, and then be finally stopped. A few laterals near the top may be permitted to push several joints; those situated lower should be pinched at an early stage of their growth, and entirely removed when the wood of the principal shoot begins to turn brown. In the beginning or middle of July the wood ought to be ripe along the whole 7 feet of rod, and any laterals remaining should be cleared off; the pots must then be removed to the south side of a wall, or any convenient shelter, and mulched with some substance which will protect the roots from the vicissitudes of cold and heat. Prune the plants in October, top-dress with a compost of rich turfy loam in November, wash them with sulphur and soft soap, and they will then be ready for forcing. About the middle of November, earlier or later ac-

cording to the urgency of the demand for early grapes, the plants should be introduced into the forcing house or pit. To insure the greatest success, the pots should be plunged in a heat of 65° or 70°; the atmospheric temperature may follow that in the table already given; and the bottom-heat ought always to be as high as the mean top-heat. Train six or eight shoots for fruiting; but in order to have the bunches fine, only one bunch should be left on each. The shoot ought to be stopped at one joint beyond the bunch. Keep the air rather dry when the plants are in flower; and supply manure water alternately with pure water. By these means 6 or 8 lbs. of well-ripened grapes may be obtained from each pot, in April, sixteen months after striking the plant from the eye.

The above may be considered one of the best modes where bottom-heat can be afforded; but, instead of raising plants from eyes in one season and fruiting them in the next, plants may be reared with less heat and fruited after two seasons' growth. In the autumn after propagation they may be cut down to two or three eyes. In February, the best shoot from these should be trained as directed for those of plants forced in the winter following the first season's growth from the eye. Some place the pots on rich compost, or in other pots nearly filled with such, in order that the roots of the vines whilst being forced may penetrate into it on passing through the hole in the bottom of the pot.

It is necessary to observe, that vines and other fruit-trees in pots are frequently treated when at rest as if they were certain kinds of bulbs, which, having a store of moisture in themselves, do not require to be supplied with any whilst vegetation is inactive. But such is not the case with vines, and unless it can be proved that the soil in which vines have lived out of doors for hundreds of years is drier in winter than in summer, we must conclude that keeping the roots of pot vines in winter in a soil as dry as dust must be very injurious to the plants.

Diseases.—The vine, grown under favourable circumstances, is not subject to disease of any kind except the vine mildew (*Oidium Tuckeri*), which of late years has attacked it almost universally. In America it has been prevalent for more than thirty years upon European vines; but was not known in England till 1847, when an account of it was given by Mr.

Tucker, of Margate, where the disease first appeared, about two years previous to that time. It has since proved very destructive to crops of grapes both in vineries and on the open wall, that would otherwise have been very fine; and not only have the vines of this country suffered severely, but the crops in the Peninsula, France, Germany, Italy, and the Greek Archipelago have in some seasons been almost destroyed. The mildew appears to the naked eye like a white powder, but under a powerful microscope it is found to consist of a network of white branching filaments, from which others, either resembling a club or necklace in shape (Fig. 261) arise, almost in a per-

Fig. 261.



pendicular direction; and by the spores and utricles of these the fungus is rapidly propagated.

When the disease becomes visible to the naked eye there is no effectual remedy. If it then be allowed to vegetate for the short space of three days on the skin of the berry, the latter is rendered incapable of a

natural distension, but the pulp and seeds continue to increase in bulk, and the consequence is that the berry cracks, so that the seeds are exposed. The further progress of the oidium may be arrested, but the lost vitality of the skin of the berry it is impossible to restore, and that being the case, prevention should be principally aimed at. The most effectual agent hitherto known is sulphur; the expense of a few pounds of which is but little compared to the value of a crop of grapes in a vinery, and the loss in future years in consequence of the injury inflicted on the constitution of the vine itself. Before commencing to force the vines, they should be dressed with sulphur, soft soap, and an infusion of tobacco; flowers of sulphur should also be scattered on the soil inside, and some may even be forked in on the border outside. Occasionally the atmosphere of the house ought to be impregnated with sulphur by means of a sulphurator, from the time the leaves begin to unfold till the berries change colour; but soon after the fruit is set, the sulphurator should be used to dust more directly the foliage. By the liberal use of sulphur in one

year, there is little danger of an attack in the following; but it is well to adopt preventive measures early in every season.

Sulphur may also be advantageously applied in the form of a vapour, with the view of preventing mildew and destroying insects. When heated to about 300° it burns in the open air, the product being sulphurous acid, a gas destructive to both animal and vegetable life. Even below its point of fusion, 232°, it gives off fumes too strong for delicate foliage, and in general it cannot be heated above 170° without danger to vegetation.

By *Shanking* is understood a disease of the foot-stalks of the berries, in consequence of which they lose their green colour and prematurely their vitality, before the berries are ripe. *Shrivelling*, of course, takes place when the berries are long exposed to a dry air after being ripe; but this is a natural consequence, and cannot be termed a disease; such it is, however, when the berries shrivel in a green state. These diseases have been assigned to various causes, such as cold borders, over-cropping, injudicious pruning, &c. We conclude that the proximate cause must be an insufficient or vitiated supply of nourishment. The supply may be insufficient in consequence of a deficiency of roots, owing to the vines having been deprived of too much foliage in the preceding season; or, there may be too great a disparity between the temperature of the ground where the roots are situated and that of the interior of the house. If we were asked to try how shanking and shrivelling could be induced on a perfectly healthy vine, we should keep the house warm and the border cold to begin with. By plenty of heat and moisture with little air, a great breadth of foliage would be rapidly expanded. The vine being previously in good health, a heavy crop of fruit ought to set upon it; but under pretence of exposing the bunches to get well coloured, we would almost denude the plant of its foliage, and that suddenly, so as to cause the latter to be out of all proportion to the weight of the fruit. Still the berries might not shank the first season; but the effects of the treatment given would probably, we could almost venture to say would certainly, begin to manifest themselves in the succeeding one; and therefore such treatment should be avoided, and the contrary adopted as the best means of preventing the evil in question.

Of insects, the greatest enemy is the red

spider (*Acarus telarius*), the attacks of which are seldom felt when the vines are growing in a rather moist atmosphere, and the roots in a border not too dry; but when the berries begin to colour, water being sparingly applied on account of the flavour of the fruit, the insects often attack the foliage to such an extent as to render it incapable of maturing the crop. Care should be taken in the first place that the roots be duly supplied with moisture. If this be properly attended to, and a sufficient degree of moisture kept up by syringing, steaming, and other means by which the drying effects of fire-heat may be counteracted, there ought to be no red spider before the grapes begin to colour; and even then, if the roots are never in want of proper moisture, the red spider will not readily commence its attacks. On account of the flavour of the grapes, water, after the period of colouring, should be sparingly given, the quantity ought to be just enough to supply the amount carried off by evaporation, and scarcely so much during the final stage of maturation. With just enough, the vines will be healthy and generally free from insects, whilst the fruit will be well swelled and of good quality. If, notwithstanding these precautions, the red spider should make its appearance, let the temperature of the house be kept in the morning at the lowest safe night minimum, which we shall suppose to be 60°. The leaves will be nearly of that temperature. Then shut up the house, and suddenly raise steam to produce a saturated atmosphere, and the moisture will be abundantly condensed on the whole surface of the cooler foliage. At the same time the syringe may be plied on the leaves, wherever it is possible to do so without wetting the bunches. If all this were done when the leaves were warmer than the air of the house, the moisture would not be condensed, and consequently not so universally diffused over every part of their surface, and the insects would struggle to get a dry breathing place, or lurk in dry corners till the evaporation of the surrounding water enabled them to resume their operations.

The vine scale (*Coccus vitis*) and mealy bug (*Coccus adonidum*) sometimes attack the vine; but by stripping off the loose bark and thoroughly cleaning the stem and shoots when the leaves are off with a brush, using soft soap and warm water, these insects may be completely cleared off. In short, by painting the

walls with lime, sulphur, and tobacco-water, by washing the rafters, but not the glass, with a solution of soft soap, by syringing and steaming, and by attention to general cleanliness, vines may be rendered secure from the ravages of insects. As for wasps, they may be trapped. A hand-glass, with a small hole in its top, may be set on three bricks, so that the wasps and flies can enter to a bait; then another hand-glass being placed over the first, the wasps will readily pass into it through the hole in the top of the lower one, but will rarely find their way back through that hole; and in this way they may be caught in great numbers.

CHAPTER XXII.

FLOWER GARDEN AND PLEASURE GROUNDS.

I.—FLOWER GARDEN.

By a flower garden is generally understood a compartment expressly allotted for the cultivation of flowers, and as such, distinct in character from the pleasure ground. In the latter, we expect to find lawn, trees, and shrubs; and although flowers of certain kinds may be appropriately introduced, yet a place of which they do not constitute the principal feature cannot be called a flower garden.

A flower garden should be complete in itself; and whatever is complete, may have a boundary beyond which it is not necessary that the view should extend; in fact, in most cases it is better that the eye should be confined solely to the scene before it. A flower garden might be laid out according to an excellent design, as regards the plan, in the midst of a large open field of grass or corn land, but the effect would not be so pleasing as if the plot were surrounded by a boundary sufficient to exclude the view of all incongruous adjoining objects.

Situation.—It is generally admitted that the flower garden should be near the house, or not more than a quarter of a mile from it; that it may be under the windows or seen from them; and that it should at all times be of easy access. The front of a conservatory is an eligible situation; or where a range of garden structures or the house has a terrace in front, a level spot at the bottom of the

slope is very proper for being laid out as a flower garden. It may happen that a piece of ground bounded by a wall on two sides could not be well brought in to harmonize with the lawn and pleasure ground, without wasting ground in plantation merely for the purpose of hiding those walls. But without losing ground in this way, a flower garden could in such a case be very well formed so as to occupy the whole of the site; for a style could be adopted that would correspond with the lines of walls, and which could be worked close to them, whether these might happen to be straight or curved. Any corner, therefore, that forms a sort of adjunct to the general lawn and pleasure ground, may be considered eligible for the site of a flower garden intended to be made complete in itself.

The *extent* depends on various circumstances, as the size of the mansion, the ground at command, and especially on the means that can be afforded for proper keeping. A small flower garden well kept is better than a large one indifferently managed.

The *exposure* may be any except northerly; and shelter ought to be provided from winds from the north and north-east; and by means of trees, the force of the gales from the south-west should be broken. For this purpose, the trees should not be so near to the garden as to occasion shade or gloominess. The spot should be low and sheltered, rather than high and exposed; but, at the same time, it should be rendered dry and comfortable by a complete system of underground drainage, and by well formed walks.

Soil.—Any good rich free garden soil on a well-drained subsoil will answer. Strong loams and clays should be avoided or removed, and replaced with soil of a more friable nature. For particular kinds of plants, peat, sandy-peat, or even leaf-mould, will have to be substituted for the natural soil; and occasionally rich friable turfy loam may be required.

Laying Out.—The modes adopted in laying out flower gardens are exceedingly various, depending on taste. Some gardens consist of a combination of geometrical figures, others partly of these, and partly of such as are not strictly so; and again, some are composed of parts bounded by easy flowing lines, and not constituting any regular individual figure, yet so arranged as to bear an evident relation to each other, and produce a harmonious whole.

The various modes may be classed under

three different styles—the *picturesque*, the *geometrical* or *formal*, and the *free symmetrical*. Hence we may conclude that in grounds of only moderate extent, the picturesque style

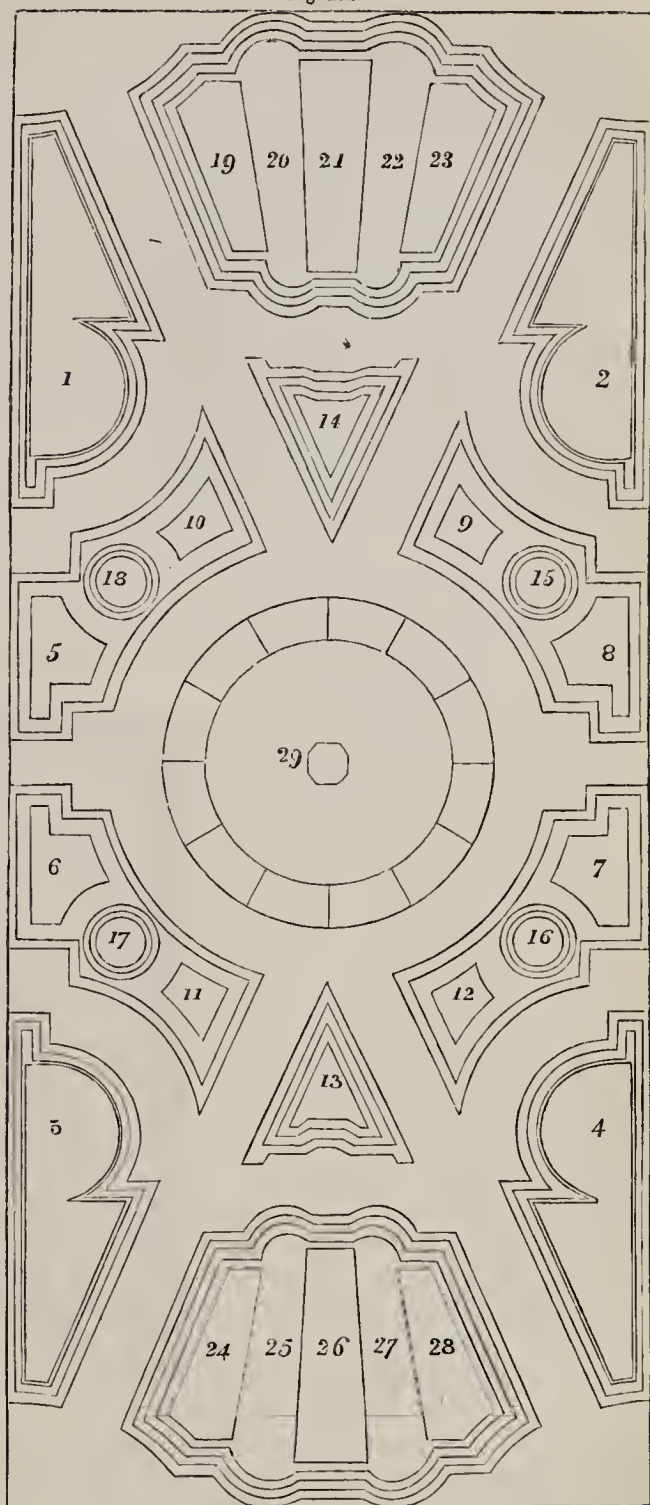
The *picturesque style* is, of all others, the most irregular; its forms are in imitation of nature. Smooth natural scenes are not the most eligible for imitation, and on the other hand, those that are dreary, rugged, and barren, cannot please. Such only should be selected as have strongly marked characteristics—wild, but yet capable of producing vegetation, and of being rendered agreeable thereby. The expression, “Ythan’s banks are wild and fair,” employed by Byron, is, we think, descriptive of what we should term picturesque scenery. That river, in some parts of its course, winds through deep ravines with a most luxuriant natural vegetation on the side facing the sun, and roots of hazel and other trees are to be seen scrambling exposed down the face of perpendicular rocks, and insinuating their small fibres into the moist and dripping crevices. Contrasting with this, the opposite side is destitute of tree or shrub, and even on the plateau at top all is barren, except some dry mosses and lichens, which crumple under the feet. If both sides had been equally barren, the scene might have been entitled to the description of wild and dreary, but not fair.

The picturesque style can rarely be well adopted as regards the flower garden, properly so called, the usually allotted space for such being too limited; but in extensive pleasure grounds there is often plenty of scope for the introduction of the picturesque in a manner that could not be considered a mere burlesque imitation of nature. A tolerably correct model of a picturesque mountainous tract could be formed on a small scale in a flower garden, but it would not bear to be ornamented with trees and shrubs; even a few tall hollyhocks would reduce the imitation mountains to mole-hills, by comparison of heights, whilst a tall cypress planted in the valley would soon overtop the adjacent mounds, and no eye could then recognize in the small heights and hollows the representation of natural scenery.

should not be attempted except when natural circumstances are very favourable.

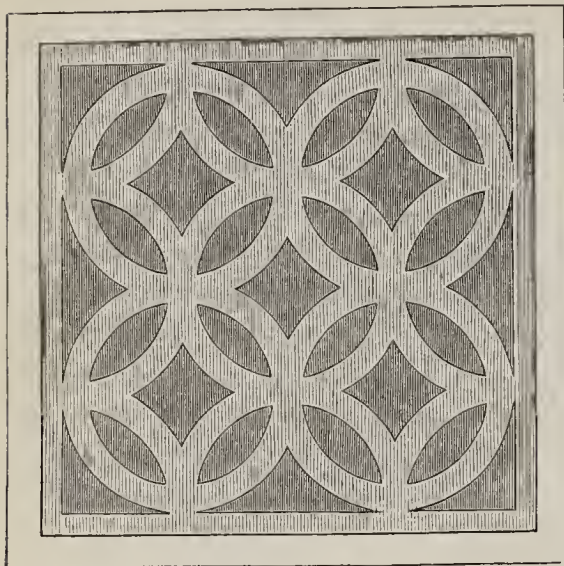
The *geometrical style*, also called the ancient, the architectural, and the formal styles, was that which anciently prevailed. Its parts

Fig 262.



consist of regular geometrical figures, each of which is formed by lines, either straight or

Fig. 263.



circular, meeting at determined points; and the line between any adjoining two of these must either be straight, or must form one regular curve, which therefore corresponds with some portion of a circle of greater or less radius, and the entire circle is of frequent occurrence.

In architectural gardens, the boundaries of forms, as was observed by Mr. Loudon, may be straight or curved, or combinations of straight and curved lines, but they never deviate into lines which might be supposed to be the work of chance. The ancient style, according to Repton, consisted in straight lines and geometrical figures, and had more reference to art than to nature.

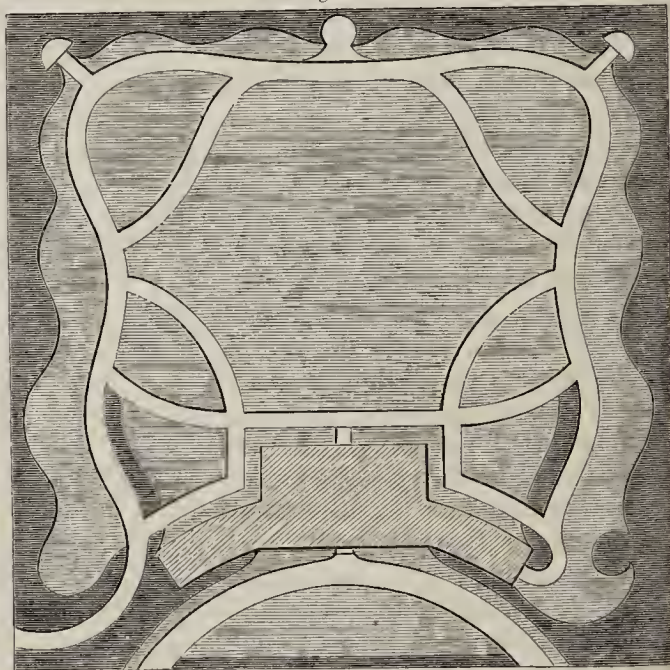
Fig. 262 is an example of a flower garden in the geometrical style, laid out at Bowood, the seat of the Marquis of Lansdowne, for which we are indebted to the kind liberality of Mr. Spencer. The engraving first appeared in that elegant and well conducted periodical, the *Florist and Fruitist*. Here every straight line is parallel to another adjacent straight line, and those that are circular correspond with others that are circular, and this in laying out should always be borne in mind. The centre is occupied by a fountain and basin. The beds have each a dressed stone-edging 3 inches wide, and rising 4 inches above the ground, next to which is a strip of yellow gra-

vel 3 inches in breadth. Then an edging of box, 4 inches wide, kept very low, and lastly, another strip of gravel. The space between the beds is grass, the parterre being surrounded by gravel walks.

Fig. 263 is another example of the geometrical style; it is formed by the intersections of five circles, four semi-circles, and four quadrants within a square; and thus, the shapes of the twenty-nine flower beds, of which the figure is composed, are determined.

The *free symmetrical style*. From the definition given of the geometrical style, it is presumed that no one could hesitate in pronouncing at first sight, whether a flower garden is in that style or not. In Fig. 262, every line joining two adjacent points, is either straight or forms a greater or less portion of the circumference of a circle, and could therefore be described with one sweep of the compasses. In Fig. 264, there are lines of this description near the house to harmonize with its architecture, but farther from the building there are wavy lines which individually could not be

Fig. 264.



traced from point to point by a single sweep with any radius from one centre. The design therefore is not purely geometrical; it is more free, but yet it constitutes a symmetrical whole, and accordingly its style may be designated the free symmetrical. This we think a more definite term than the *mixed*, the *middle*, the *irregular*, or the *gardenesque*, as this style is also called. It is a style which admits

of greater freedom and adaptation than the strictly geometrical; and while freedom is allowed, a due regard is also paid to regularity—conditions that cannot fail to maintain this style in permanent estimation. Fig. 264 is a good example of it; and on observing the disposition of the walks, it will be seen how a piece of ground in the form of a square or parallelogram may be laid out so as to give variety combined with fitness and symmetrical arrangement.

Beds.—These admit of great variety in their forms and arrangement. The regular straight-lined figures consist of the triangle, square, parallelogram, rhombus, rhomboid, pentagon, hexagon, and other equal sided or regular polygons; but it may be observed that any of the latter with more than eight sides, or the octagon, ought not to be introduced in gardens, because they approach so near the circle that it is better to substitute the latter. Of the above, the triangle, parallelogram, and rhomboid, may be infinitely varied according to the differences that may be made as regards the relative lengths of their sides; all the other figures, and also the circle, can only vary in magnitude not in form.

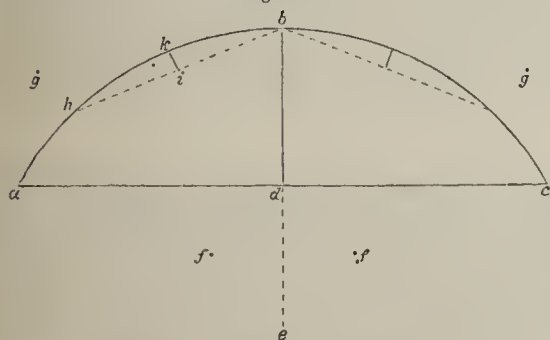
The circle should be well studied before a flower garden is attempted to be laid out. By making its radius longer or shorter, curves, either great or small, may be made to correspond with any regularly curved line. But before this can be done, it is necessary to find the centre of the circle, of the circumference of which the curved line is a portion. This can be effected on paper by the rules of practical geometry, but some instructions as to the mode in which curves may be traced on the ground may prove useful. Let it be re-

quired to find the radius of the curve $a b c$, fig. 265; and suppose the cord $a c$ to be 60 feet, and the perpendicular $b d$ 18 feet. Then multiply $a d$, the half chord, by itself, divide

the product by $b d$, and add $b d$ to the quotient; the sum will be equal to the diameter of the circle, and the half, of course, will be the radius. Thus $\frac{30 \times 30}{18} + 18 = 68$, and $\frac{68}{2} = 34$, the radius; and this distance measured from b will reach to e , the centre of the circle, with a portion of the circumference of which the curve $a b c$ coincides. To trace this on the ground, take a line or chain, fix one end by a ring or loop on a stake at e , and with a tracer at the distance of 34 feet from e move round, keeping the line or chain stretched, and the curve will be correctly described. Sometimes, however, the radius may be too great, or obstructions may exist in the way of the line. In such cases, at any convenient distance from e , place rods at $f f$, and others to be in line with $f e$ as at $g g$. Measure from e towards g , at the length of the radius insert rods, and they will be in the curved line, in which there will then be five points determined; and in the same way as many more as may be necessary can be marked out. Or between points already determined, as from h to b , measure the length of the straight line or chord $h b$; square the half of that length, divide the product by twice the radius $b e$ already found, and the quotient will be equal to the perpendicular from the middle of that chord to a point in the circumference. It will be observed, that if another straight line were drawn from h to k , the distance between it and the curve would be very little. It may, however, be easily calculated by the same rule. But any more points will scarcely be necessary, as a line can be pegged so as to admit of the curve being cut out correctly enough by any workman who has a tolerably good eye for lines. For extensive sweeps, a thick rope can be laid so as to form a very regular curve, without the angles which a thin line makes at the pegs.

In fig. 266 are represented a number of geometrical forms, which may be employed singly, or in combination with others, and as suggestions it is presumed they will be found useful. The form represented at a , is required as in the centre of fig. 267, where the straight sides of a square would not suit the adjacent curves; b, c, d will be more suitable in some cases than parallelograms; e, f, g, h have curved ends or sides, to correspond with circular lines adjacent; m admits of plants in the middle of the square being reached; in n , four standard roses

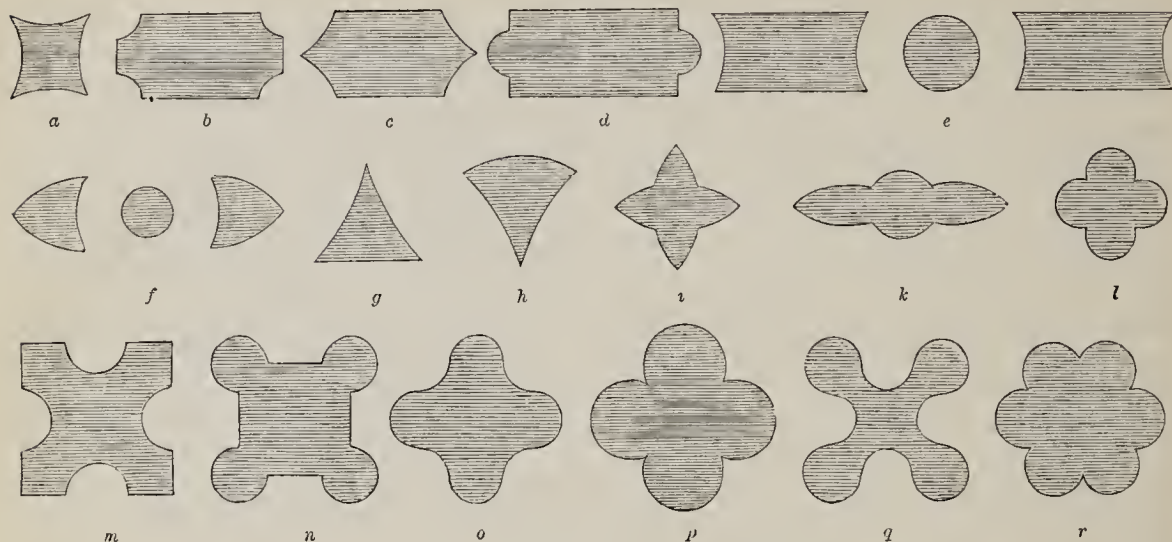
Fig. 265.



quired to find the radius of the curve $a b c$, fig. 265; and suppose the cord $a c$ to be 60 feet, and the perpendicular $b d$ 18 feet. Then multiply $a d$, the half chord, by itself, divide

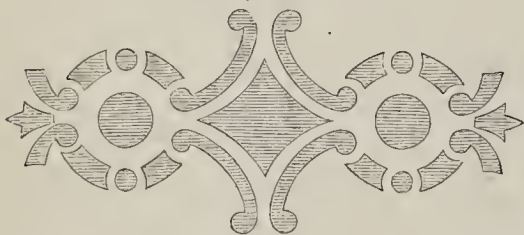
may fill the eircles, whilst other plants may occupy the square. The others may be employed to relieve the monotonous outline of the circle, or the heaviness of the square.

Fig. 266.



In cases where it is desirable to have flower beds on each side of a straight walk, beds of

Fig. 267.

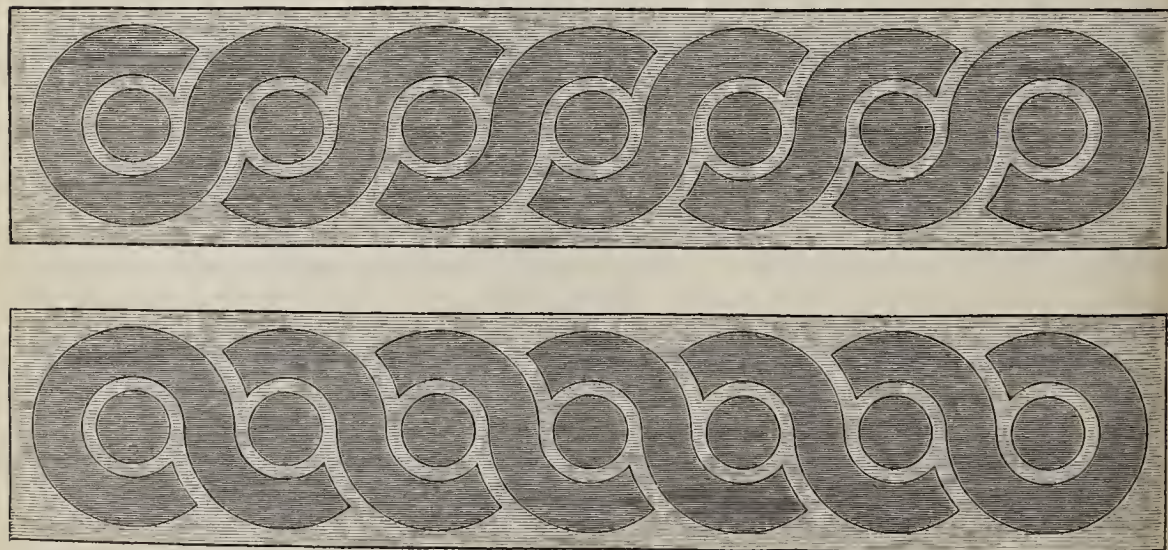


the form represented in fig. 268 have an excellent effect, being less monotonous than a

succession of straight-lined figures, even when these are connected together by eircles; and eypresses, yews, or standard roses, may be planted in the eircles between the S-like beds. The device is also well adapted for surrounding parterres laid out in the geometrical style.

The mode of constructing these figures on paper will be obvious enough to almost any one, but to transfer the plan of a flower garden from the paper to the ground requires some praetice. To do it easily and correctly, it must be proceeded with systematically, otherwise some error would soon occur, and in the

Fig. 268.



proecess one error leads to others, till by degrees confusion prevails, and the labour of tracing out the lines must be begun afresh.

Before commencing, straight rods for marking certain points on the ground should be prepared. A line and measuring-rods will

also be necessary, and a chain with foot links, or a measuring-tape, will likewise be convenient. For tracing the outlines of small figures, wooden compasses, and more especially the sort of beam compasses described at p. 134, will be useful, for by them the circumference of circles, or portions of such, can be readily traced. A large **T** square, with each bar say 10 feet in length, with the cross bar moveable, so as to be set at any angle, will facilitate many operations. There is little difficulty in laying down any individual figure on ground; but where a design, constituting a regular whole, is composed of a number of figures, each of which must not only be correct in itself, but likewise occupy its proper position with reference to the others, method is required. The position of the principal lines and points should be first determined; for example, in laying down Fig. 262, mark, in the first place, the four corners of the parallelogram; stretch between them lines, which may be of small twine, or better, whip-cord. From each angle let a line be stretched to the opposite angle, and where the two lines cross is the centre of the plot, and of the circle 29; the various circles around this may then be traced. Divide the parallelogram lengthwise in two by a line half way between the two sides; mark where it crosses the circles in the points of beds 13 and 14, and insert rods where it does so. From these points on the plan, extend the straight sides of the triangles 13, 14, till they intersect the ends of the parallelogram; ascertain the distance of these intersections from the adjoining corners, and at that distance from each corner of the ground place rods; stretch lines from these rods to those already placed at the angular points of 13 and 14; and it will then be an easy matter to mark all the lines that are seen to run parallel to these. The main lines of the design having been thus determined, the difficulty and chance of error in laying down the other will be greatly lessened. Lines drawn through the centres of 15, 16, 17, 18, and parallel to the sides, will touch the figures containing beds 19 to 23, and 24 to 28, at the termination of their straight sides; let corresponding lines be marked on the ground, and also the distances of the points along the sides where lines at right angles, if extended, would cross the lines drawn parallel to the sides in the centres of the four circles. Find the centres of the circular parts of 1, 2, 3, 4, and these parts can then be described.

It would be desirable to have the plan, and likewise the ground, included within a square or parallelogram, taking care that the ends and sides are at right angles. The plan may then be divided into a number of squares to the scale of 8 feet, or 16 feet on the sides, because the individual squares can then be divided and subdivided to unity, without having to use inches in the process. The squares on the plan should be numbered; and to correspond with these, squares must be laid out on the ground and numbered in a similar manner. In the latter case, it will be found convenient to place the number of pegs so as to mark the centres of the squares, which may readily be found, by stretching lines from the opposite angles. Where intricate figures occur in any square, it can be subdivided into four, and each of these again into four, if necessary.

Fig. 263 may appear complicated, but it may, nevertheless, be laid down correctly on the ground without the necessity of constructing many squares. Mark the corners of the square to be laid out in the above figure with stakes; find the centre of each side, and on each side of these centres, lay off half the intended breadth of the walks, driving in pegs at that distance. Every two adjoining pegs will thus be at a distance from each other equal to the breadth of the walk. Stretch a line from each peg to the one immediately opposite to it on the other side of the ground, which will thus be divided into four squares, each intruding upon its neighbouring squares by a distance equal to half the breadth of the walk, and four smaller squares within these, which do not intrude upon each other. Find the centres of the larger squares by drawing lines from corner to corner; drive in pegs to mark these centres, and one in the centre of the square of ground, which will likewise be found by this process; also other pegs where the diagonals intersect each other near the centre of each side of the ground. The distance of these pegs from such centres will be equal to half the breadth of the walk. There are now nine pegs inserted within the square, each of which will serve as the centre of a circle. With a radius touching the sides of the larger squares describe a circle round each centre, and with a radius touching the internal sides of the smaller squares, or, in other words, a radius equal to that formerly employed, *less* the breadth of the walk, describe circles within those already formed. Lastly, with the stakes

at the corners of the piece of ground as centres, and with radii touching the points where the adjoining curves intersect the sides of the square, describe two quadrants in each corner.

In many cases it will be found most convenient and sure to fix certain important points by triangulation, employing one or more lines already fixed as bases. The position of any point opposite one of them, may be thus found on the ground:—Lines from the point to each end of the base line will form a triangle; take two measures, equal in length to the respective sides of the triangle; extend them from the ends of the base line, and where they meet when stretched is the position of the point. It may be observed, that the triangles may be of any form, but the nearer they are to equilateral ones the better.

By the modes here explained, or by others that it may be found convenient to adopt, according to circumstances, any one may easily lay out a flower garden, even although the plan should be of the most intricate description.

After the outlines of the beds have been determined, the soil should be raised with a gentle swell above the level of the sides, and with due regularity, so as not to render the beds like unsightly heaps of earth; at the same time, it is necessary to observe that the soil should not press upon the edging, it should be just as high on one side of this as the gravel is on the other, and no higher. The edging is intended to mark a distinct line between the soil and the walk, but we have seen an old edging of box made to serve, as it were, the purpose of a terrace wall, being closely backed by soil raised at least 6 inches above the gravel on the opposite side. Instead of this, the soil, as already mentioned, ought to meet the edging on the same level as the gravel, and it ought to maintain that level for a few inches back from the edging, or, if anything, rather rising; then it may gently curve upwards as much as will give the beds a full appearance, and permit superfluous moisture to run off. The gravel walk, if firmly made, will not become lower to any appreciable extent, but the loosened soil of the bed will be sure to do so; therefore when dug, and before being levelled to the proper height, it should be trodden rather firmly with the foot lengthwise along the back of the edging.

Walks.—The formation of walks generally,

and the modes of levelling them, having been already treated on, we have only to offer a few remarks with regard to those in flower gardens and pleasure grounds. The walks should be so composed as to be fit for walking upon as soon as possible after rain, even as quickly as sunshine alternates with April showers. In order that such may be the case, the curve of the walk should be perfectly uniform and the surface firm; and that it may nevertheless appear clean and new, it ought to receive a thin coating of gravel, sifted so as to be neither too fine and soft, nor on the other hand coarse. In some parts it is difficult to obtain gravel for the surface sufficiently free from loam, but the gravel may be washed free from the loam under cover in wet weather, when other work cannot be carried on.

When a walk runs along the base of a slope, it should not in any case have less than a foot of level ground next it, but 3 feet or more would be better, if space will permit. And if ground slope from near the edge of a walk, there should be at least 2 feet of level ground between the commencement of the slope and the walk, so as to make it appear that the latter is sufficiently based.

It is desirable that walks running parallel, or nearly so, should not be seen from each other; nor should they pass near to a coach-road within the grounds, or even to a road outside. It is also highly objectionable for many walks to be seen from the same point of view. No walk should change from a straight to a curved direction without some obvious reason. The object may ultimately be seen; but something should be introduced, as a tree, shrub, clump, or piece of rockwork, to give an apparent reason for turning aside.

From this it may be inferred, that in going along a walk, two bends should rarely be seen at once, certainly not three or four times, for then it becomes evident that the walk could have been made straight, and has been purposely contorted. It is a rule laid down by Repton, and approved of by Loudon and others, that when walks diverge from each other, they should do so as if they would not soon meet again. Curved walks in juxtaposition with straight lines do not harmonize; and it will be observed, on referring to Fig. 264, that the walks are straight where they run along by the straight front of the building, although curved elsewhere. Walks forming the boundaries of a piece of ground in the form of a

square or parallelogram, should not be made to round off the corners, except in some cases where a little of the sharp angle that would otherwise crumble down may be taken off. When walks cannot be conducted continuously from one direction to another, without producing a constrained or awkward turning, they may be made to terminate in a circle, and from such they may proceed in any required direction, only they ought not to enter the circle obliquely.

Rockwork.—There is a wide difference of opinion with regard to the formation of rockwork in flower gardens and pleasure grounds. Some would aim at a representation of a portion of the Alps, or perhaps of the Rocky Mountains, but such imitations should never be attempted unless they can be worked out on a grand scale, as at Chatworth; on a few square yards they become ridiculous. The introduction of rockwork may, in our opinion, be made not only with a view to ornamental effect, but also to give diversity to a level scene, to hide objects where a hedge, plantation, or wall, would be unsightly or inadmissible, and to afford facilities for the cultivation of a beautiful and interesting class of plants, which either would not thrive, or could not be seen to such advantage on level ground. As an intervention to hide objects not desirable to be seen from the pleasure grounds, rockwork is in many cases far preferable to a bank of earth planted with shrubs. It may be said that the rockwork would have the disadvantage of being too bare in winter, but to remedy this, it may, if of any considerable extent, be constructed so as to admit of rare and elegant evergreen shrubs being planted upon it.

It is not necessary to see rocks piled on rocks, as they may be seen in the grand scenes of nature, unless it be to convince one how insignificant is the attempt of man to imitate them; but from natural assemblages of rocky materials on a comparatively small scale, useful hints may be derived, and particularly from such as are intermixed with vegetation.

The general form of the intended piece of rockwork should be first determined. A bank or mound of earth is then generally thrown up according to that form, and covered with stones, but leaving small spaces for the plants; this we may observe is an objectionable mode, for the soil forming the nucleus becomes too compact and impervious to moisture, espe-

cially if it is of an adhesive nature. We would therefore recommend that the nucleus be formed of stones where they are plentiful, or of brick rubbish; but if soil must be chiefly used, let it be covered to the depth of 6 or 8 inches with small stones, or very coarse sandy gravel for drainage.

The materials employed for rockwork may consist of such rough stones as can be readily found in the neighbourhood; and in parts of the country where stones cannot be easily obtained, masses of half vitrified bricks, called burrs, will answer very well. Rugged irregular forms can also be imitated with pieces of brick united by cement, and the whole coloured with thin cement and a sprinkling of lampblack. In placing the masses, variety should be studied by making them project, recede, and incline differently. If, however, a sloping ledge in imitation of natural strata is seen in one part, similar ledges in other parts should have the same slope. Cavities should be formed for soil, and these ought not to be like square boxes, but somewhat irregular in the length and height of their sides, and frequently with the north one highest. In placing the stones, the necessary depth of soil to be introduced between them should be allowed for, and also the growth of the plants. From not attending to this, pieces of rockwork, in other respects well constructed, have lost all their character in a few years, the finer projections being completely overgrown.

Architectural decorations, such as statues, vases, and fountains, are the most appropriately introduced in gardens attached to houses in the Grecian and Italian styles, but unless constructed of stone, or some good durable imitation of stone, and executed in the best manner, they are better dispensed with. All architectural ornaments should stand on a firm horizontal base; therefore turf should not be laid up to stonework, for as the grass grows, the horizontal line of the base is continually interfered with; gravel has a much better appearance next stone foundations—not, however, that which is fine and sandy, but good binding unsifted gravel, well rolled. Vases are usually placed on terraces and parapets, or on pedestals at the terminations of walks. Statues and busts may be placed by the sides of walks and as terminating objects; but in gardens we think they should be sparingly introduced. Fountains and basins are appropriately situated in a circular space at the inter-

sections of walks, where, in fact, they are of the readiest access for obtaining a supply of water from them. They may also be introduced with good effect in the centre of geometrical flower gardens. Temples may be placed at the terminations of walks, or on elevated ground. They should be constructed of stone, or of some material in imitation of it, and must always correspond in point of style with the architecture of the house.

Summer-houses belong more to the pleasure ground than to the flower garden; they are generally formed of rough unbarked timber, which for this, as indeed all other purposes of construction, should be felled in autumn. They may be covered with heath or thatch, and climbers, but, unless corresponding in style with the house, should not be visible from its windows. Arbours are, from the shade and retirement which they afford in summer, desirable introductions in gardens. They may be readily formed under weeping trees, or by training climbers over a wire framework.

II.—PLEASURE GROUNDS.

No precise directions can be given as to the mode in which these should be laid out, for it depends on an infinite variety of circumstances. The peculiarities of each particular place, such as the extent and form of the ground available for the purpose, the position of the house, the elevation of its site with respect to the adjoining ground, the position of its adjuncts, the style of architecture in which it is built, the views near and distant, &c., require to be taken into account by a person on the spot. Such being the case, it will generally be necessary to consult professional men where extensive operations are about to be commenced. We shall therefore merely offer some remarks that will probably be found useful in many cases.

It is presumed that before any steps for laying out the grounds are taken, the plan of the mansion and of all buildings will have been fixed upon. Then it can be taken into consideration in the first place, what large trees should be planted, not only for shelter, but also for giving support to the house, as it is termed, in a landscape point of view. In doing this, care should, however, be taken that no trees are planted too near the mansion. When the value of fresh air as regards health was not so well understood as it is at the present day, mansions were in numerous instances

built on too low ground, and then so masked with trees, that a free circulation of air was impossible. We do not mean to say that there ought to be no trees near a house—quite the contrary; but they should be planted more judiciously than we have frequently observed to be the case. The nature of the trees to be planted ought to be known; the size they are likely to attain should be estimated, or rather the spread of their tops; and, taking this into account, they should be planted so as not to overhang within 10 or 15 feet of the house. It may be objected that this would be too wide a gap between the trees and the house; but the opening can be closed, so far as the view is concerned, by planting a large kind of tree opposite to the opening, but distant enough from the building as well as from other trees.

Although houses are now generally well drained, yet, even in that case, quantities of ammonia, sulphuretted hydrogen, and other noxious gases, are carried into the ground by rain, from court-yards and other places, rendering its exhalations unwholesome. Trees afford perhaps the best means of purifying the soil from these matters, for the roots will absorb, and the leaves decompose them in vast quantities. The fallen leaves, it is true, would generate some of these gases again if allowed to lie and rot; but they can be swept up and dug in where the ground is poor, or they can be otherwise disposed of. The roots of trees in soil near dwellings are in the above respect highly beneficial, and should therefore be encouraged. It may be objected that they would injuriously affect the growth of flowers and other plants which it might be desirable to have near the house; but trench the ground 3 feet deep, and there will be plenty of depth of soil for flowers above the roots of the trees.

In selecting the kinds of trees to be planted, the form which their tops will ultimately assume is not a matter of indifference. If the mansion is in the Grecian style, pyramidal trees will contrast best with it; but for the Gothic or any pointed style, round-headed trees are the most suitable. The position of large trees having been fixed in the first instance, roads, walks, and fences can be planned so as to run at a proper distance from them. Nothing appears more awkward or more indicative of want of forethought, than a large tree with its bole encroaching upon the edge of a walk, or pressing against a fence, for in such

cases it is evident to every passer by, that either the walk, or the tree, or the fence, is out of place.

The better the shelter provided on the north, north-east, and north-west sides, the warmer will be the mansion and its adjoining pleasure grounds; and the warmer the drier, and consequently the more pleasant and healthy. Therefore the largest and strongest trees that will succeed in the soil, ought to be planted so as to break the force of the winds coming from these quarters. Often when a cold northerly wind prevails, the sky is clear, and well sheltered spots are rendered warm by the accumulation of heat from the sun's rays, but remove the shelter, and that genial accumulation is soon scattered by the blast.

The positions of the large trees necessary to be planted as adjuncts to the buildings and for shelter having been determined upon and marked out, the limits of the space to be allotted for pleasure ground should then be ascertained and traced out on a rough plan. On this, lines should be dotted in the direction of any views that it may be desirable to leave open; and in planting, respect must of course be paid to these lines, in order that tall trees or shrubs may not be placed in positions where they are likely to obstruct the view.

The boundaries having been traced out, the next thing is to sketch the interior. A considerable portion seen from the windows should consist of lawn, not, however, without a single tree or evergreen shrub in it, but lawn should form the principal feature. The general area of this may be comprised within a square or parallelogram, or some approach thereto, and a temporary line, representing the boundary of such area, should be sketched on the plan. It will then be seen what ground remains available for groups or masses of trees, shrubs, or flowers, and for walks to pass amongst these. Scarcely any trees, except for the purposes already mentioned, will be admissible in the portion of ground near the house, but shrubs will be necessary. They should not, however, be disposed as a regular belt; they are better in groups with walks gently winding between them. To admit of giving varied forms to these groups, the temporary boundary line of lawn can be broken in upon in certain places by some of the clumps of shrubs, and not approached by as much in others. According to this process of taking and giving, the space

allotted for lawn will be still much the same as originally intended; but its otherwise formal outline will be changed into one having agreeable recesses alternating with bold projections, for in this case a tame, gently winding line, seen to be such along its whole course, is worse than one which is perfectly straight. A belt with a straight or regularly curved outline is not agreeable when viewed in connection with the rest of the pleasure ground; but this objection may be readily obviated by drawing a regular line, and then forming inward and outward curves on both sides of it. These curves should not be uniformly alike; on the contrary, they should exhibit variety, and this they can be made to do to any extent. Some of the projections may be as bold as they possibly can be without being abrupt, and the recesses may be equally deep, but frequently gentler curves may be introduced.

Lawn.—Before the preparation of the ground for a lawn is commenced, the level or levels of the surface ought to be determined. This is necessary, in order that the loosening of the soil may be performed to a uniform depth, with the exception of a slight decline which the bottom of the trenches should have towards drains, whether the surface be made to a slope in the same direction or not. In many cases the height of the ground will have to be regulated by that of the ground line of walls, terraces, parapets, or other buildings. The general level of the undisturbed ground should then be ascertained, in order that if a difference is proved, soil may be brought in, or, on the contrary, taken away if the ground be found to be too high. When trenched it will of course be for some time higher than it previously was, but it will ultimately sink to the measurement taken whilst it was in a compact state. It is advisable to trench the ground to the depth of not less than 18 inches on account of shrubs that may be planted in certain places. In soils and situations where the grass is apt to parch or sunburn, trenching to the above depth will tend to prevent that effect from taking place. Near Paris, to insure the rarity of a green lawn in summer, the Baron Rothschild had some of his ground not only trenched but manured. In rocky ground the above depth of trenching may be found to involve too great an expense for the means at disposal; in that case, a foot of loosened soil may be deemed sufficient; shrubs can be selected that will be suitable for that depth, and in

parching weather, a green sward may nevertheless be maintained by watering occasionally in the evening. But the depth, whatever it may be, should be regular, measuring from the intended surface; for if trenched irregularly, deep in some cases and shallow in others, the consequence will be that the grass, though laid down so as to exhibit at the time a perfectly level surface, will afterwards become uneven; for where deeply loosened, the earth will subside more than where the trenching was shallow, and the surface becomes, in a year or two, full of heights and hollows, rendering it necessary that the turf be taken up and relaid. Lawns that are uneven are much more expensive to keep than those that have a plane surface, and not only this, but the tint is not uniform where inequalities exist; whether the mowing machine or the scythe be employed, the elevated portions are shaven to the quick, whilst the grass in the hollows is left comparatively long, the former presents a pale appearance for several days after mowing, the latter a bright green, and the whole lawn has a spotty aspect. Besides, every elevation above the general level takes off the edge of the scythe, and occasions much loss of time in whetting. Great advantage will therefore arise from due precautions being taken in the first instance to insure a smooth surface. When the trenching is completed, the surface should be levelled by the spade, and then raked to remove the stones. Presuming that this is done in winter, it will be advisable to let the ground remain untouched till some heavy falls of rain have occurred; for these will have a great effect in consolidating it, and that more equally than can be done by beating or ramming. As soon after the rain as the ground is in working order, it should be tried by levelling instruments, and any inequalities regulated accordingly. It should then be pointed over, and, when in working order, made perfectly level by the rake. It will then be ready either for turfing or sowing down.

If good turf, such as that of some commons, can be procured, a firm lawn may be at once established, more free from weeds and coarse grasses than by sowing down. The turf should be regularly cut and rolled up; this is done near London in yard lengths, 1 foot broad, and about $1\frac{1}{2}$ inch thick. Of course they should be laid as soon after cutting as possible. Particular care should be taken that the rolls do not get frozen, otherwise the vitality of the

grass may be destroyed; for although the natural grasses are hardy, yet we have known blanks result from using turf that has been frozen in a rolled-up state.

Before laying down the turf, some cover the surface of the ground with sifted coal ashes, in order to keep the lawn free from worm-casts. The latter are troublesome, it must be admitted, but raking and sweeping will disperse them. Being composed of fine soil, the greater part is washed in among the roots of the grass, forming a top-dressing which is peculiarly beneficial to the finer grasses—in fact, it is that kind of top-dressing in which they exist for ages in perpetual verdure on the commons. Were it not for the fresh soil brought to the surface from a considerable depth by the worms, it is probable that the same kind of grass would get tired, as the expression is, of the same soil, and would disappear, as in fact is the case with regard to some lawns. In another point of view, the worms are of vast importance, and that is in draining the surface. In a wet day no one thinks of walking for pleasure on grass; but in a dry day, when it would be presumed that the most delicate might traverse the lawn, how great the disappointment to find the ground swampy under foot! We have seen instances of this, and such would be more frequent were it not for the boring operations of the worms. Their passages, extending from the surface to the subsoil, afford the most ready means of draining the former, and rendering it free from that unpleasant swampiness so highly objectionable in lawns. On the whole, we should not be inclined to use any precautions against the worms at first; but if the soil is naturally so light and porous that their assistance is not required, they may be destroyed at any time by means of limewater.

The turfs should be laid down on the perfectly even surface by a line, and this will show whether there are any heights or hollows in consequence of inequalities in the thickness of the turf. Where this is thin introduce a little soil below, where thick let some be taken out. As soon as this first breadth of turf is made fair, let it be equally but slightly beaten; then proceed in a like manner with the next breadth, and so on. When laid down, let the whole be well and equally beaten with the turf-beater, and it may at the same time be once rolled over. It should then remain undisturbed till the grass has made fresh

roots; for if rolled when the under surface of the turfs are thickly set with the protusions of young and tender spongioles, these would be apt to get bruised by rolling until such time as they have secured themselves by penetrating the soil below. It is needless to observe, that if dry weather set in, newly turfed lawns should be kept well watered.

Where turf cannot be had in sufficient quantity to cover the ground at once, lawns have been formed by inoculation, that is, small pieces of turf are inserted at equal distances with a trowel. If a piece of 3 inches square is allowed for every square foot of surface, a lawn may be inoculated with 1-16th of the turf necessary for laying it down at once. In order that the grass may the more readily spread over the whole surface, the intervals between the inserted pieces should be raked, and not rolled or beaten till the patches meet, which they will likely do in a twelvemonth, or even soon after midsummer, if the operation has been performed under favourable circumstances, either in autumn in time for the patches to get rooted before winter, or early in spring. Until the ground is covered, the grass should not be so closely mown as is usual with established lawns.

When the ground has to be sown down, it should be levelled as for turfing, well trodden, and raked smooth; then sow, rake lightly and evenly, and, lastly, roll, and the operation is complete.

The following are the kinds and quantities of seed for an acre:—

	Lbs.
<i>Cynosurus cristatus</i> ,	5
<i>Festuca duriuseula</i> ,	3
„ <i>ovina tenuifolia</i> ,	2
<i>Lolium perenne tenue</i> ,	20
<i>Poa nemoralis</i> ,	2
„ „ <i>sempervirens</i> ,	2
„ <i>trivialis</i> ,	2
<i>Trifolium repens</i> ,	6
„ <i>minus</i> ,	2
<i>Trisetum flavescens</i> ,	1
	—
	45

The above proportions will be found suitable to the generality of soils; but in shady situations, to which *Poa nemoralis* and its variety are particularly well adapted, 1 or 2 lbs. of each of these may be substituted for *Trisetum flavescens* and *Festuca tenuifolia*; whilst in rich heavy soils, 2 or 3 lbs. of *Cynosurus cristatus*, and 1 lb. of *Festuca duriuseula* may be substituted for *Trisetum flavescens*,

the quantity of *Trifolium minus* being reduced to 1 lb.

Keeping of Lawns.—This consists principally in rolling, mowing, and sweeping; occasionally watering may be requisite; weeds and bad grasses should be rooted up, and a top-dressing may in some cases be found necessary. Rolling should be done the day previous to mowing. The latter operation must still be done by the scythe where there are many trees, flower-beds, or grass terraces; but in extensive lawns, it is much more cheaply done by a mowing machine drawn by a horse. Small machines worked by two or three men are not on the whole considered much more economical than the scythe in good hands.

The mowing of lawns is a tolerably easy process to those who can do it well, but to those who cannot, it is hard labour. These should practise on some outskirt till they become expert enough to leave no traces of ill-directed force, and until they can make the edge of the scythe throughout its whole length sweep at a uniform height above the surface, instead of paring it in places, and thus leaving the face of the lawn marked for days with numerous unsightly scars. Although nothing but a considerable amount of practice will make a man a good mower, yet there are some points which might be attended to with advantage as regards his own ease and workmanship. In the first place, a good edge should always be maintained. In whetting, the stone should be kept very nearly flat when applied to the under side of the blade, but so as to make a slight, yet straight bevel on the upper side. On some tender portion of smooth lawn, with a very sharp edge requiring little force, make a full but easy sweep, then slowly make another, but in doing so, observe to make the heel of the scythe follow almost closely the curve which the edge of the standing grass is seen to represent before you. The whole edge from point to heel will thus be brought into play in cutting. In this way the half of the blade next the heel cuts as much as the half nearest the point. The resistance of the grass against both halves is therefore the same, but in consequence of the greater leverage exercised against the portion farthest from the handle, the resistance there is doubly felt. Care should therefore be taken to keep the heel of the scythe moving closely to the curved portion of the uncut grass, following in very nearly the same curved line as that described

by the point at the previous stroke; in practice the heel should, however, be kept a little within the curve—say 1 inch or 2, but the less the better—in order to make sure of not passing any of the standing grass. As regards mowing long grass for hay, the above principle holds good. By attending to it, a man could do a certain amount of work with at least one-fourth less exertion than would otherwise be required, and at the same time he could make better work.

Sweeping should be done so as not to leave any portions of cut grass to wither, for such become tough, and will obstruct the edge of the scythe at the next mowing. Some, instead of sweeping, use rakes with short, thickly set teeth.

Before the scorching effects of long-continued drought and hot sun are manifested on lawns, they should be supplied with water. This should be done towards night. When the surface is well moistened before the vitality of the plant is seriously affected by scorching, fresh roots will form rapidly in the hot moist soil, and before this gets too much dried up, if there is no appearance of rain, another good watering should be given. Whether the water be supplied by means of carts, such as those employed for watering roads, but with broad wheels, or through wide roset watering-pots, the expense will not be much, compared with the advantage of insuring a freshness of lawn at the time, and maintaining a proper texture of living roots immediately beneath the surface, and so preventing the grasses from perishing.

Among the weeds with which lawns are infested, the dandelion is the most conspicuous; to-day its flower scapes may be so low as to escape the scythe; but in a day or two its yellow flowers are elevated in full view. It may be readily destroyed by cutting off the crown of leaves and placing a little salt on the wound, or by pouring a small quantity of sulphuric acid upon it. The flower heads of daisies should be gathered by the daisy rake, and the plants themselves may be extirpated by the weeding-iron, by which also cock's-foot grass and all other plants that interfere with the smoothness and uniform tint of the lawn may be destroyed.

Some prefer mossy lawns, others the superior verdure of grass only. The latter may be insured by top-dressings of rich compost, which may consist of fresh loam of a friable nature,

free from stones, or, if otherwise, screened, in order to prevent injury to the edge of the scythe or the cutter of the mowing-machine; mix the loam with farm-yard manure, and turn occasionally till the whole is in a well-divided state. If the top-dressing is applied to the thickness of $\frac{1}{4}$ inch, or at the rate of 34 cubic yards per acre, and allowed to remain without rolling till washed down by rain, the freshness of the lawn will soon be restored. This could be done more readily by guano or liquid manure, but the effects of these would not be permanent, and their smell is offensive. Should one dressing of compost not produce the desired result, another ought to be given. In particular cases, the compost may be sifted on after mowing, and so that the grass may hide it in a few days.

Ornamental Water.—In flower gardens the extent of water must be limited, otherwise it would bear too great a proportion to the extent of land seen in connection with it, and, accordingly, it is in them chiefly confined to basins and fountains; but in extensive pleasure grounds and in parks, water is so important a feature, and contributes so much to the beauty and enlivenment of natural scenery, that no landscape can be considered altogether complete without it. In nature, from a certain point of view, a river, broad and swelling, may be observed to disappear in winding behind some wood or rising ground, and again appear in full view, till, by following the lowest course it can take through valleys, it finally becomes lost to the sight. But what is seen of it has a much more noble appearance than the same extent of surface in the form of a circular pond. Now, an artificial piece of water can be formed so as to appear and disappear like a natural river, and then no one can reasonably find fault with it. The introduction of water in pleasure grounds is a delicate point; but if we can give it every appearance of a broad river, or of a natural lake, the difficulty will be overcome. The banks of the piece of water may exhibit beautiful curves, as those of natural rivers frequently do; for instance, the Thames near Chiswick, the place where Hogarth lived, forms a curve that corresponds very well with what is called Hogarth's line of beauty. In short, water in many cases may be easily introduced and with good effect, if the above simple example is borne in mind; and we shall only add, that all water, whether in lakes,

ponds, or basins, should be kept as clear and pure as possible, and all walks near it should be rendered dry, otherwise the scenery cannot be comfortably viewed. There may, however, be a piece of smoothly shorn lawn between the walk and the water's edge. Where there is a considerable stream, the water can be easily kept clear; but where the supply is scanty, so that there can be but little overflow, great care is necessary in introducing vegetation in its neighbourhood; for if many large trees of a deciduous nature are planted on the banks, the leaves cannot be prevented from falling into the water and rendering it impure. Therefore, in such a case, lawn and evergreens, with a sparing admixture of deciduous shrubs, are to be preferred for the positions nearest the water; while trees of tall growth may be planted at such a distance as to preclude the possibility of their leaves falling in large quantities into the water. Exception ought, however, to be made in favour of the weeping-willow and birch.

Planting Trees and Shrubs in Pleasure Grounds.—Having touched upon the modes in which gardens are laid out, we may now proceed to the planting of trees and shrubs in the pleasure ground, where, with the lawn, they form the principal objects of ornament.

The planting of large trees should be first taken into consideration; then the larger kinds of shrubs; and, finally, the smaller shrubs by way of filling up. If shrubs are planted more thickly than would be proper for their after growth, they can be occasionally thinned and regulated; but with regard to large species of trees, although they may seem far enough apart when planted, from then occupying the space perhaps of only a single shoot, yet frequently after eight or ten years' growth, it becomes evident that they have been planted too closely, and at the same time if any were removed, an irregular blank would be occasioned. Very great care should therefore be taken in planting trees that ultimately attain a large size.

In small places very few large trees can be properly admitted. Some near the house, and for shelter, as already mentioned, are, however, in most cases desirable. It will be neces-

sary to ascertain from the plan, or from the ground, how many large trees can be introduced; and on looking over a list of species, let one of the most desirable be marked, then another, and so on till as many have been selected as the space will contain. The selection may comprise such as the following:—

DECIDUOUS TREES.

Acer Lobelii.
Betula alba.
Castanea vesca.
Cratægus Oxyacantha, Double White
 and Scarlet Thorns.
Fagus sylvatica.
 " " *purpurea.*
Juglans regia.
Platanus occidentalis.
Quercus pedunculata.
 " *sessiliflora.*
Sophora japonica.
Ulmus campestris.
 " *montana vegeta.*

EVERGREEN.

Araucaria imbricata.
Cedrus Libani.
 " *Deodara.*
Cupressus macrocarpa.
Ilex Aquifolium.
Pinus austriaca.
 " *exceclsa.*
 " *Laricio.*
 " *Pinaster.*
 " *sylvestris.*
Quercus Cerris Lucombeana.
 " *Ilex.*
Sequoia sempervirens.
Taxus baccata.
Wellingtonia gigantea.

If space permit, the following would also be desirable.—

Acer macrophyllum.
Æsculus Hippocastanum rubicunda.
Betula papyracea.
Cytisus Laburnum.
Liquidambar styraciflua.
Liriodendron tulipifera.
Negundo fraxinifolium.
Quercus coccinea.
 " *Phellos.*
 " *Suber*, in a warm situation.
Robinia Pseud-Acacia.

After the places of the large trees have been marked out, the small trees and shrubs may be selected, and to assist in doing this we give the following lists:—

DECIDUOUS TREES.

	Feet.		Feet.		Feet.
ACER campestre,	30	ACER macrophyllum,	60 to 80	ACER Pseudo-Platanus purpurea	
circinatum,	30 to 40	platanoides,	40 to 60	rubrum,	30 to 60
eriocarpum,	40	Pseudo-Platanus,	60	saccharinum,	40
Lobelii,	50	albo variegata		striatum,	20

	Feet.		Feet.		Feet.
<i>ÆSCULUS Hippocastanum</i> , . . .	60	<i>CYDONIA sinensis</i> , . . .	15	<i>POPULUS nigra</i> , . . .	60 to 80
<i>rubicunda</i> , . . .		<i>vulgaris</i> , . . .	15	<i>tremula</i> , . . .	50
<i>AILANTHUS glandulosa</i> , . . .	60	<i>CYTISUS Laburnum</i> , . . .	20 to 30	<i>PRUNUS Aria</i> , . . .	20 to 30
<i>ALNUS cordifolia</i> , . . .	40	<i>alpinus</i> , . . .	20 to 30	<i>Aucuparia</i> , . . .	20 to 30
<i>glutinosa</i> , . . .	40 to 60	<i>ELÆAGNUS angustifolia</i> , . . .	20	<i>baccata</i> , . . .	15 to 20
<i>laciniata</i> , . . .		<i>EUONYMUS latifolius</i> , . . .	10 to 20	<i>coronaria</i> , . . .	20
<i>AMYGDALUS communis</i> , . . .	20 to 30	<i>FAGUS sylvatica</i> , . . .	60 to 80	<i>Sorbus</i> , . . .	30 to 50
<i>macrocarpa</i> , . . .		<i>asplenifolia</i> , . . .		<i>spectabilis</i> , . . .	20 to 30
<i>BETULA alba</i> , . . .	50	<i>purpurea</i> , . . .		<i>torminalis</i> , . . .	30 to 40
<i>pendula</i> , . . .		<i>FRAXINUS excelsior</i> , . . .	40 to 80	<i>QUERCUS Ægilops</i> , . . .	30
<i>lenta</i> , . . .	60	<i>aurea</i> , . . .		<i>alba</i> , . . .	60 to 80
<i>nigra</i> , . . .	60	<i>pendula</i> , . . .		<i>Cerris</i> , . . .	60 to 80
<i>papyracea</i> , . . .	60	<i>juglandifolia</i> , . . .	50	<i>coccinea</i> , . . .	80
<i>BROUSSONETIA papyrifera</i> , . . .	30	<i>lentiscifolia</i> , . . .	40	<i>Esculus</i> , . . .	30
<i>CARAGANA arborescens</i> , . . .	10 to 20	<i>GLEDITSCHIA sinensis</i> , . . .	30 to 50	<i>fastigiata</i> , . . .	40
<i>CARPINUS Betulus</i> , . . .	40	<i>triacanthos</i> , . . .	50 to 60	<i>macrocarpa</i> , . . .	60 to 80
<i>CARYA alba</i> , . . .	50	<i>GYMNOCLADUS canadensis</i> , . . .	30	<i>pedunculata</i> , . . .	50 to 100
<i>amara</i> , . . .	60	<i>HALESIA tetraptera</i> , . . .	10 to 20	<i>heterophylla</i> , . . .	
<i>olivæformis</i> , . . .	60	<i>JUGLANS nigra</i> , . . .	60 to 80	<i>Phellos</i> , . . .	60
<i>CASTANEA vesca</i> , . . .	70	<i>regia</i> , . . .	60	<i>rubra</i> , . . .	80
<i>heterophylla</i> , . . .		<i>KOLKEUTERIA paniculata</i> , . . .	20	<i>sessiliflora</i> , . . .	50 to 100
<i>CATALPA syringæfolia</i> , . . .	30	<i>LIQUIDAMBAR styraciflua</i> , . . .	30 to 40	<i>tinctoria</i> , . . .	80
<i>CELTIS crassifolia</i> , . . .	30 to 50	<i>imberbe</i> , . . .	15	<i>RIUS typhina</i> , . . .	20
<i>occidentalis</i> , . . .	30 to 50	<i>LIRIODENDRON tulipifera</i> , . . .	60 to 80	<i>ROBINIA Pseud-Acacia</i> , . . .	50 to 70
<i>CERASUS Mahaleb</i> , . . .	20	<i>MACLURA aurantiaca</i> , . . .	20	<i>viscosa</i> , . . .	40
<i>Padus</i> , . . .	20	<i>MAGNOLIA acuminata</i> , . . .	30 to 40	<i>SALIX alba</i> , . . .	60 to 80
<i>virginiana</i> , . . .	30	<i>auriculata</i> , . . .	20 to 30	<i>babylonica</i> , . . .	30 to 40
<i>Common double-flowering</i> , . . .	20	<i>Soulangeana</i> , . . .		<i>caprea</i> , . . .	20 to 30
<i>French double-flowering</i> , . . .	30	<i>conspicua</i> , . . .	20 to 30	<i>fragilis</i> , . . .	70
<i>CERCIS Siliquastrum</i> , . . .	20	<i>glauca</i> , . . .	10 to 20	<i>pentandra</i> , . . .	20
<i>CORNUS florida</i> , . . .	20	<i>Thompsoniana</i> , . . .		<i>Russelliana</i> , . . .	80
<i>mas</i> , . . .	15	<i>macrophylla</i> , . . .	20 to 30	<i>vitellina</i> , . . .	20
<i>CORYLUS Columna</i> , . . .	30 to 40	<i>tripetala</i> , . . .	20 to 30	<i>SAMBUCUS nigra</i> , . . .	20
<i>CRATÆGUS Aronia</i> , . . .	20	<i>MORUS alba</i> , . . .	20 to 30	<i>laciniata</i> , . . .	
<i>coccinea</i> , . . .	20	<i>nigra</i> , . . .	20 to 30	<i>racemosa</i> , . . .	10 to 15
<i>cordata</i> , . . .	20	<i>rubra</i> , . . .	40 to 50	<i>SOPHORA japonica</i> , . . .	50
<i>Crus-galli</i> , . . .	20	<i>NEGUNDO fraxinifolium</i> , . . .	30	<i>pendula</i> , . . .	
<i>Douglasii</i> , . . .	15	<i>ORNUS europæa</i> , . . .	30	<i>TILIA americana</i> , . . .	60
<i>flava</i> , . . .	15	<i>PAULOWNIA imperialis</i> , . . .	30	<i>argentea</i> , . . .	50
<i>heterophylla</i> , . . .	20	<i>PAVIA flava</i> , . . .	30 to 40	<i>europæa</i> , . . .	60
<i>macracantha</i> , . . .	20	<i>rubra</i> , . . .	10 to 20	<i>ULMUS campestris</i> , . . .	60 to 80
<i>nigra</i> , . . .	20	<i>PLANERA Richardi</i> , . . .	50	<i>latifolia</i> , . . .	
<i>orientalis</i> , . . .	20	<i>PLATANUS occidentalis</i> , . . .	60 to 80	<i>sarniensis</i> , . . .	
<i>Oxyacantha</i> , . . .	15 to 20	<i>orientalis</i> , . . .	50 to 60	<i>stricta</i> , . . .	
<i>multiplex (double white)</i> , . . .		<i>POPULUS alba</i> , . . .	90	<i>viminalis</i> , . . .	
<i>pendula</i> , . . .		<i>angulata</i> , . . .	70	<i>effusa</i> , . . .	60
<i>punicea</i> , . . .		<i>balsamifera</i> , . . .	40	<i>montana</i> , . . .	60
<i>flore pleno</i> , . . .		<i>fastigiata</i> , . . .	100	<i>australis</i> , . . .	
<i>rosea</i> , . . .		<i>græca</i> , . . .	40	<i>pendula</i> , . . .	
<i>tanacetifolia</i> , . . .	20	<i>monilifera</i> , . . .	100	<i>vegeta</i> , . . .	
<i>CYDONIA lusitanica</i> , . . .	15 to 20				

EVERGREEN TREES.

ARBUTUS Andrachne,	20	ILEX balearica,	10 to 20	one with handsome
hybrida,	10 to 20	latifolia,	15	leaves.
Unedo,	10 to 20	opaca,	10 to 20	QUERCUS, Cerris fulhamensis, 70
BUXUS sempervirens,	15 to 20	MAGNOLIA grandiflora,	20 to 30	Lucombeana, 70
ERIOBOTRYA japonica,	10 to 15	Large white fragrant		Ilex, 20 to 40
ILEX Aquifolium,	20 to 30	flowers from Aug. to		latifolia
Varieties with variegated		Oct.; exoniensis and		Suber, 20 to 30
leaves, and yellow		præcox earlier flower-		Turneri, 40
berries.		ing varieties; obovata,		virens, 40

HARDY CONIFERS,

Including the Yews and their allies.

<i>ABIES alba</i> , . . .	30 to 50	<i>ABIES excelsa elegans</i> , . . .	5	<i>ABIES nigra pumila</i> , . . .	4
<i>glauca</i> , . . .		<i>pygmæa</i> , . . .	2	<i>orientalis</i> , . . .	70
<i>Brunoniana</i> , . . .	70	<i>stricta</i> , . . .	3	<i>Pattonii</i> , . . .	100
<i>canadensis</i> , . . .	70 to 100	<i>Kämpferi</i> , . . .		<i>rubra</i> , . . .	70
<i>Douglasii</i> , . . .	100 to 150	<i>Menziesii</i> , . . .	60	<i>Smithiana</i> , . . .	50 to 100
<i>excelsa</i> , . . .	100	<i>Mertensiana</i> , . . .	100	<i>ARAUCARIA imbricata</i> , . . .	50 to 100
<i>Claubrasiliana</i> , . . .	4	<i>nigra</i> , . . .	70	<i>BIOTA orientalis</i> , . . .	20 to 30

	Feet.		Feet.		Feet.
<i>BIOTA orientalis aurea</i> , . . .	5	<i>JUNIPERUS japonica</i> , . . .	2	<i>PINUS excelsa</i> , . . .	100 to 150
<i>compacta</i> , . . .	10	<i>macrocarpa</i> , . . .	10	<i>Hartwegii</i> , . . .	40 to 50
<i>cupressoides</i> , . . .	20	<i>nana</i> , . . .	1	<i>insignis</i> , . . .	80 to 100
<i>glauc</i> , . . .	15	<i>oblonga</i> , . . .	5	<i>Lambertiana</i> , . . .	100 to 150
<i>pendula</i> , . . .	15	<i>occidentalis</i> , . . .	30	<i>Laricio</i> , . . .	80 to 100
<i>CEDRUS atlantica</i> , . . .	60 to 100	<i>Oxycedrus</i> , . . .	10	<i>Lindleyana</i> , . . .	50
<i>Deodara</i> , . . .	80 to 150	<i>phœnicea</i> , . . .	10 to 20	<i>macrocarpa</i> , . . .	80 to 100
<i>viridis</i> , . . .		<i>prostrata</i> , . . .	1	<i>Pallasiana</i> , . . .	70 to 80
<i>Libani</i> , . . .	50 to 100	<i>recurva densa</i> , . . .	5 to 10	<i>Pinaster</i> , . . .	50 to 70
<i>argentea</i> , . . .		<i>rigida</i> , . . .	10	<i>Hamiltonii</i> , . . .	
<i>CEPHALOTAXUS drupacea</i> , . . .	20	<i>Sabina</i> , . . .	2 to 6	<i>Pinea</i> , . . .	20
<i>Fortunii</i> , . . .	20 to 40	<i>variegata</i> , . . .		<i>ponderosa</i> , . . .	60 to 100
<i>pedunculata</i> , . . .	20 to 30	<i>sabinoides</i> , . . .	3	<i>pumilio</i> , . . .	20
<i>CHAMÆCYPARIS sphæroidea</i> , . . .	30	<i>squammata</i> , . . .	3	<i>pyrenaica</i> , . . .	60 to 80
<i>atrovirens</i> , . . .		<i>tetragona</i> , . . .	5	<i>resinosa</i> , . . .	70 to 80
<i>glauc</i> , . . .		<i>thurifera</i> , . . .	30	<i>rigida</i> , . . .	60
<i>variegata</i> , . . .		<i>virginiana</i> , . . .	40	<i>Sabiniiana</i> , . . .	100
<i>CRYPTOMERIA japonica</i> , . . .	60 to 100	<i>glauc</i> , . . .		<i>Strob</i> , . . .	60 to 100
<i>Lobbii</i> , . . .		<i>pendula</i> , . . .		<i>alba</i> or <i>nivea</i> , . . .	
<i>nana</i> , . . .	3	<i>variegata</i> , . . .		<i>sylvestris</i> , . . .	80 to 100
<i>CUNNINGHAMIA sinensis</i> , . . .	30 to 40	<i>LARIX europæa</i> , . . .	80 to 100	<i>rubra</i> , . . .	
<i>CUPRESSUS attenuata</i> , . . .	10	<i>pendula</i> , . . .		<i>PODOCARPUS koraiana</i> , . . .	5
<i>Benthami</i> , . . .	50	<i>LIBOCEDRUS chilensis</i> , . . .	40	<i>SALISBURIA adiantifolia</i> , . . .	30
<i>funeris</i> , . . .	50	<i>PICEA amabilis</i> , . . .	100	<i>SEQUOIA sempervirens</i> , . . .	100 to 200
<i>Goveniana</i> , . . .	50	<i>balsamea</i> , . . .	20 to 30	<i>TAXODIUM distichum</i> , . . .	80 to 100
<i>Knightiana</i> , . . .	50	<i>bracteata</i> , . . .	120	<i>sinense</i> , . . .	12 to 20
<i>Lawsoniana</i> , . . .	50 to 100	<i>cephalonica</i> , . . .	50	<i>TAXUS adpressa</i> , . . .	4
<i>Macnabiana</i> , . . .	15	<i>grandis</i> , . . .	100	<i>baccata</i> , . . .	20 to 40
<i>macrocarpa</i> , . . .	60	<i>nobilis</i> , . . .	100	<i>Yellow-berried Yew</i> , . . .	} pretty varieties.
<i>sempervirens</i> , . . .	30 to 40	<i>Nordmanniana</i> , . . .	80	<i>Silver-striped</i> , . . .	
<i>Uhdeana</i> , . . .	50	<i>pectinata</i> , . . .	80 to 100	<i>Yellow variegated</i> , . . .	
<i>GLYPTOSTROBUS heterophyllus</i> , . . .	10	<i>Pichta</i> , . . .	30 to 50	<i>Dovaston</i> , . . .	
<i>JUNIPERUS chinensis mas</i> , . . .	20	<i>Pindrow</i> , . . .	80 to 100	<i>Irish</i> , . . .	
<i>communis</i> , . . .	10 to 15	<i>Pinsapo</i> , . . .	60	<i>Variegated Irish</i> , . . .	
<i>hibernica</i> , . . .		<i>Webbiana</i> , . . .	80	<i>THUJA gigantea</i> , . . .	60 to 100
<i>hispanica</i> , . . .		<i>PINUS australis</i> , . . .	60 to 80	<i>occidentalis</i> , . . .	30 to 40
<i>suecica</i> , . . .	10 to 15	<i>austriaca</i> , . . .	100	<i>plicata</i> , . . .	20
<i>drupacea</i> , . . .	10	<i>Benthamiana</i> , . . .	100 to 150	<i>THUJOPSIS borealis</i> , . . .	?100
<i>echinoformis</i> , . . .	2	<i>Brutia</i> , . . .	60	<i>WELLINGTONIA gigantea</i> , . . .	100 to 300
<i>excelsa</i> , . . .	30	<i>Cembra</i> , . . .	50		

III.—HARDY DECIDUOUS SHRUBS.

Amelanchier Botryapium—15 feet. Flowers very numerous and highly ornamental, white; April and May. Seeds and grafting.

Amelanchier vulgaris—10 to 20 feet. Flowers extremely numerous, white; March and April. Very ornamental. Seeds and grafting.

Amorpha fruticosa—10 feet. A handsome shrub with pinnated leaves and purple flowers; July and August. Cuttings and layers.

Amygdalus nana—2 to 4 feet. Flowers numerous and highly ornamental, single or double, rose-coloured; March and April. Budding on the plum. Warm situation.

Amygdalus orientalis—10 feet. Leaves silvery. Flowers rose-coloured; March and April.

Aralia spinosa—6 to 12 feet. Leaves large, treble pinnate. Flowers in large panicles, whitish; August and September. Seeds, suckers, and cuttings of the shoots and roots. Light moist soil.

Azalea.—The hardy *Azaleas*, by the brilliant colours and profusion of their sweet-scented flowers, form, with the *Rhododendron*, a magnificent display in summer. The varieties are exceedingly numerous, presenting every shade of red, white, and yellow, as well as a great diversity of marking, but as new and improved seedlings are being continually added, any selection given here would be of little permanent value. The propagation

and culture are the same as in the case of the *Rhododendron*.

Berberis vulgaris—10 feet. Ornamental by its foliage, and its red, purple, or violet-berries in autumn. Seeds, layers, and suckers.

Calophaca wolgarica—3 feet. A very ornamental little shrub producing a profusion of yellow flowers; May and June. Seeds.

Calycanthus floridus—6 to 8 feet. Flowers reddish brown, very odoriferous; June and July. Layers and suckers.

Caragana Chamlagu—3 to 4 feet. A spreading shrub with large yellow flowers; May and June. Seeds and grafting on *C. arborescens*.

Caragana frutescens—6 to 10 feet. Leaves composed of 4 leaflets. Flowers yellow; May. Seeds, and when grafted it forms a handsome pendulous tree.

Caragana pygmaea—3 feet. A low-spreading shrub, with small yellow flowers. It may be introduced with good effect in flower-gardens when grafted standard high on *C. arborescens*; it then forms a nice round head.

Cerasus Chamæcerasus—4 feet. A species with slender branches, shining leaves, and white flowers; April and May. It forms, when budded standard high, an ornamental pendulous tree.

Cerasus japonica multiplex—(*Amygdalus pumila* and Dwarf Double-blossomed Almond of the nurseries)—4 feet. Leaves ovate, tinged with red at the margin.

Flowers numerous, double, red; March to May. Highly ornamental. There is a very pretty variety with double white flowers.

Chimonanthus fragrans—8 feet. Flowers small, but numerous, pale yellow, extremely fragrant; December to February. There is a variety, *C. grandiflorus*, with larger flowers, though not so fragrant. Layers. Requires a wall, except in warm situations, and the blossoms should be protected from frost.

Chionanthus virginica—12 feet. Leaves large, lanceolate. Flowers numerous, in large racemes, white; June. Layers, and seeds on a slight hot-bed. Moist loamy soil.

Clethra alnifolia—4 feet. Ornamental by its spikes of white flowers; July and August. Layers and suckers. Moist peat soil, and a shady situation.

Colutea arborescens—12 feet. Of rapid growth and producing numerous yellow flowers throughout the summer. Seeds and cuttings of the roots. *C. cruenta*, with blood-red flowers, is also a desirable shrub.

Comptonia asplenifolia—4 feet. Leaves oblong, linear, sinuate, sprinkled with shining dots, very ornamental. Suckers and layers. Peat soil, and a rather shady situation.

Coriaria myrtifolia—A pretty little shrub with leaves resembling those of the myrtle. The berries are poisonous. Suckers, and cuttings of the roots.

Cornus alba—10 feet. Shoots of a fine coral red. Flowers white; June and July. Berries white.

Cornus sanguinea—15 feet. Shoots red. Flowers white; June. Berries very numerous, purple. There is a variety with variegated leaves. Seeds, layers, and suckers.

Coronilla Emcrus—4 to 10 feet. A very ornamental shrub, with red and yellow flowers; April to June. Seeds, cuttings, and layers.

Corylus Avellana heterophylla—10 feet. A variety of the Common Hazel, remarkable for its lacinated hairy leaves. *C. purpurea*, another variety, has very ornamental deep purple leaves.

Cotoncaster acuminata, *frigida*, and *nummularia*, are handsome shrubs, attaining the height of from 10 to 15 feet, and the scarlet berries with which the former two are covered in autumn and winter have a very ornamental effect. Layers.

Cydonia japonica—4 to 6 feet. A beautiful flowering shrub covered with a profusion of splendid scarlet blossoms in March, April, and May, and succeeding either as a bush or against a wall. There is a variety with white flowers. Layers, suckers, and cuttings of the roots.

Cytisus albus—5 to 8 feet. Leaves very small, silky. Flowers numerous, and highly ornamental, white; May and June. There is a variety with flesh-coloured flowers.

Cytisus purpureus—3 feet. Procumbent. Flowers purple, numerous, and very ornamental; May to Aug. There are varieties with rosy purple and white flowers, also one of more pendulous habit.

Cytisus capitatus, *elongatus*, *nigricans*, *sessilifolius*, and *supinus*, are also very ornamental, by their numerous yellow flowers in summer. Seeds, layers, and grafting on the Laburnum. *C. elongatus*, *purpureus*, and *supinus*, when so treated, form handsome pendulous trees.

Daphne Mezereum—3 to 5 feet. Flowers small but numerous, and very ornamental, pink, sweet-scented;

January to March. There is a variety with white, and another with red flowers. Seeds. The plant, it may be remarked, is poisonous.

Dentzia gracilis—2 feet; and *D. scabra*—6 feet, are highly ornamental flowering shrubs producing numerous clusters of snow-white flowers; May and June. *Gracilis* answers exceedingly well for forcing. Cuttings and layers.

Diervilla canadensis—3 feet. A low bush with shining leaves and small yellow flowers; June to September. Seeds, suckers, cuttings, and layers.

Euonymus latifolius—10 to 20 feet. Ornamental by its large red fruits, which ripen in September. Seeds, cuttings, and layers.

Forsythia viridissima—8 feet. A pretty Chinese shrub with oblong dark green leaves, and a profusion of bright yellow flowers appearing before the leaves, in winter and spring. Cuttings and layers.

Fothergilla alnifolia—3 feet. Shoots and under side of the leaves covered with white down. Flowers white, sweet-scented; April and May. Layers and cuttings. Moist peat soil.

Genista—Of this genus there are several species suitable for rockwork and planting in the front of shrubberies, where they are very ornamental when covered with their yellow flowers in summer. The most desirable are *G. atnensis*, *procumbens*, *purgans*, *sagittalis*, and *sibirica*. Seeds, layers, and cuttings.

Halesia tetraptera—15 feet. Very ornamental by its small, pendulous, pure white flowers; April and May. Layers, and cuttings of the roots.

Halimodendron argenteum—5 feet. Shoots grayish, spiny. Leaves small, white, and silky. Flowers purplish; May to July. It may be grafted on the Laburnum.

Hamamelis virginica—10 feet. Flowers numerous, yellow, in autumn and winter. Layers.

Hibiscus syriacus—5 to 8 feet. Flowers large, red, purple, white or striped, according to the variety; August and September. Seeds and layers. Highly ornamental.

Hippophae rhamnoides—8 to 15 feet. Leaves linear lanceolate, silvery. Berries numerous, orange. Cuttings, layers, and suckers. Succeeds well near the sea.

Hydrangea arborescens, *japonica*, *nivea*, and *quercifolia*, are dwarf shrubs, very ornamental in summer when covered with their large white flowers. Cuttings and layers. Light rich soil kept moist.

Hypericum Kalmianum and *prolificum*, are ornamental little plants producing an abundance of yellow flowers; June, July, and August. Seeds, cuttings, and layers.

Itea virginica—4 feet. A pretty shrub with numerous white flowers; July. Layers, and cuttings of the roots. Peat soil, and a shady situation.

Jasminum fruticans—6 feet. Flowers small but numerous, yellow; May to September. Layers and suckers. Warm situation.

Kerria japonica—syn. *Corchorus japonicus*—3 to 6 feet. Flowers yellow, double in the cultivated variety, numerous and very ornamental; spring and summer. Cuttings and suckers. Suitable for borders and training on walls and fences.

Leycesteria formosa—6 feet. A pretty shrub with dark green shoots and leaves, and purplish flowers, in summer, succeeded by deep purple berries. Seeds and cuttings. A wall, or sheltered situation, with slight protection in winter.

Ligustrum vulgare (Privet)—10 feet. Valuable for hedges and as a screen. Seeds, cuttings, and suckers.

Lonicera tatarica—6 to 8 feet. A very hardy species, with small red or white flowers; April and May. Seeds and cuttings.

Lonicera pyrenaica, with white flowers, *iberica* orange, and *xylosteum* yellow, are also desirable species.

Magnolia purpurea—4 to 8 feet. Leaves large, ovate, dark green. Flowers large and numerous, purple on the outside, white on the inside; April to June. Layers and cuttings. Loam and peat. A highly ornamental shrub, requiring a wall in cold situations.

Myrica Gule—3 feet. Leaves oblong, sprinkled with yellow resinous dots. Catkins reddish; May. Seeds, layers, cuttings, and suckers. Peat soil.

Paliurus aculeatus (Christ's Thorn)—7 to 15 feet. Shoots very spiny. Leaves small, ovate, shining. Flowers small, yellow; June and July; succeeded by a fruit somewhat resembling a straw hat. Seeds on a hot-bed, suckers, and cuttings of the roots.

Paria discolor—4 to 8 feet. Flowers large and numerous, yellow and purple; May and June. Very ornamental. Seeds, and grafting on the Horse Chestnut.

Pavia macrostachya—10 feet. Flowers in long racemes, white, sweet-scented; July and August. Layers. Moist soil. A highly ornamental shrub, well adapted for planting in a shady situation, or by the sides of ponds or lakes.

Persica.—The double red and white peaches have a very ornamental effect when covered with blossom early in spring. They may be grown as bushes, as low trees, or better against a wall. Besides the above there are two new Chinese peaches sent out by Mr. Glendinning, and which are likely to prove of the greatest value—namely, the Camellia-flowered, with splendid deep crimson blossoms, and the Carnation-flowered, with blossoms striped like a Carnation.

Philadelphus coronarius—8 to 10 feet. Leaves ovate, dark green. Flowers in racemes, white, exhaling a sweet but powerful odour; May and June. There is a variety with variegated leaves, which is worthy of cultivation; also a dwarf kind attaining the height of 2 or 3 feet, but which rarely flowers. Layers and cuttings.

Philadelphus Gordonianus—8 feet. Flowers large, white, numerous, and very ornamental; July. Seeds, cuttings, and layers.

Philadelphus latifolius—6 to 10 feet. Flowers white, produced in great profusion; May and June. Layers, cuttings, and suckers.

Philadelphus speciosus—10 feet (*grandiflorus* of some). Flowers large and very numerous, white; June. An exceedingly ornamental shrub.

Potentilla fruticosa—3 feet—and its variety *tenuiloba*, are ornamental little plants with yellow flowers; July and August.

Prinos verticillatus—6 feet. Flowers small, white; July and August; succeeded by small red berries. Seeds, layers, and suckers. Moist, shady situation.

Punica granatum—15 to 20 feet. The double variety of this is very ornamental in July and August, when covered with its large scarlet flowers. Grafting, cuttings, and layers. A wall with a warm aspect and protection to the roots in winter. Of course when the fruit is the object, the single variety should be cultivated.

Pyrus arbutifolia—4 feet. Flowers numerous, white; May. Fruit dark red. Seeds, suckers, and grafting. Very ornamental.

Rhodora canadensis—2 to 4 feet. Leaves oval, pubescent beneath. Flowers appearing before the leaves, purplish, sweet-scented. Layers. Peat soil.

Rhus Cotinus—6 feet. Leaves roundish, obovate, bright green. Flowers small, in elegant panicles; June and July. Layers. Very ornamental.

Rhus glabra—10 to 15 feet. Very ornamental in autumn by its bright red fruit.

Ribes aureum—6 feet. Flowers numerous, bright yellow, exhaling a sweet perfume; April and May. Cuttings and layers. Very ornamental.

Ribes sanguineum—6 feet. Flowers pendulous, varying from pale rose to dark red, produced in great profusion; March and April. Seeds, cuttings, and layers. A well known and highly ornamental species.

Ribes speciosum—6 feet. Flowers pendulous, deep red, with long stamens; May and June. Layers and cuttings. Very ornamental, especially when trained against a wall.

Robinia hispida—6 feet. One of the most ornamental of shrubs by its Acacia-like leaves, and numerous large rose-coloured flowers appearing from May to September. Seeds, and grafting on *R. Pseud-Acacia*. Sheltered situation.

Rubus fruticosus (Common Bramble)—The varieties of this with double-white and rose-coloured flowers have an ornamental effect when in blossom, and will grow anywhere.

Rubus laciniatus—5 to 10 feet. Ornamental by its deeply cut foliage and numerous rose coloured or white flowers.

Rubus odoratus—6 feet. A pretty species with large red flowers; June to September.

Shepherdia argentea—8 feet. Ornamental by its silvery leaves.

Spiraea—The most ornamental species of this pretty genus are *S. aricefolia*, *grandiflora*, *hypericifolia*, *Lindleyana*, *opulifolia*, *prunifolia flore pleno*, *salicifolia*, and *ulmifolia*, with white flowers; and *S. bella*, *Douglasii*, and *callosa*, with rose-coloured flowers. Seeds, cuttings, layers, and suckers.

Staphylea trifolia—8 to 10 feet. Leaves ternate. Flowers pendulous, white; May and June. Seeds, cuttings, and suckers.

Styrax officinale—6 to 12 feet. Leaves shining, hoary beneath. Flowers large and numerous, white; June and July. Seeds, layers, and cuttings. Light rich soil, and a wall or sheltered situation.

Symphoricarpos racemosus—6 feet. Flowers small, rose-coloured; July to September; succeeded by numerous large white berries which have a pretty effect in autumn and winter. Suckers and layers.

Syringa persica (Persian Lilac)—6 feet. Flowers numerous, and highly ornamental, purple; April and May. There is a pretty variety with lacinated leaves, and one with white flowers. Suckers and layers.

Syringa rothomagensis saugeana—10 feet. A variety having flowers of a brighter colour and in more compact thyrses than the preceding.

Syringa vulgaris (Common Lilac)—10 to 20 feet. A well known and very ornamental shrub, producing in May a profusion of fragrant flowers, and which are lilac, purple, red, bluish, or white, in different varieties. Seeds, suckers, and layers.

Syringa Emodi white, and *Jossilaea* deep lilac or purple, are also very ornamental species, and deserve a place in every garden.

Tragopyrum lanceolatum—2 to 3 feet. Flowers white; July and August. Cuttings and layers. Peat soil.

Viburnum Lantana—10 to 15 feet. Leaves very ornamental in autumn, when they become of a fine deep red. Flowers numerous, white; June; succeeded by red berries which change to black. Seeds and layers.

Viburnum Lentago—10 feet. Flowers numerous, white; July. Berries black.

Viburnum Opulus sterilis (Guelder Rose)—6 to 12 feet. Flowers in large corymbs, white; May and June. Highly ornamental.

Vitex Agnus-Castus—6 feet. Leaves digitate, hoary beneath. Flowers in racemes, small, white or bluish; September. There is a variety, *V. latifolia*, with broader leaves and larger flowers of a blue colour. Layers, and cuttings under a hand glass.

Weigela rosea—5 feet. This beautiful shrub, represented in Plate V, is a native of the north of China, whence it was sent to this country by Mr. Fortune, in 1844. Its numerous, large, rose-coloured and white flowers are produced in clusters during April and May, at which period the plant has a most ornamental effect. It is readily propagated by cuttings and succeeds well in common garden soil. This *Weigela* is likewise a very ornamental plant for the conservatory, and it may be potted, and forced in a warm pit. *Weigela coræensis* commonly called *W. amabilis*, is another splendid shrub, producing a profusion of deep rose-coloured flowers in autumn.

IV.—HARDY EVERGREEN SHRUBS.

Andromeda polifolia, *calyculata*, *floribunda*, *axillaris*, and *Mariona*, are very ornamental little evergreens, growing to the height of from 1 to 3 feet, and producing pretty bell-shaped pink or white flowers in spring. Seeds and layers. Peat soil, and a shady situation.

Arbutus Andrachne—10 to 20 feet. Bark smooth, reddish, peeling off annually. Leaves oblong, shining. Flowers white; March and April. Seeds, layers, and grafting on *A. Unedo*. Requires protection in winter when young.

Arbutus Unedo—10 to 20 feet. Flowers pendulous, white; succeeded by red berries somewhat resembling strawberries. There are varieties with red and semi-double flowers. Layers, cuttings, and seed sown in heat.

Arctostaphylos Uva-ursi—1 foot. Procumbent. Leaves small, shining. Flowers pale red; April to June; succeeded by small red berries. Seeds and layers. Peat soil. Suitable for rockwork.

Artemisia Abrotanum (Southernwood)—2 to 3 feet. Cultivated for the fragrance of its finely-divided leaves.

Aucuba japonica—4 to 6 feet. Leaves large, pale green, blotched and mottled with yellow. Cuttings and layers. A valuable shrub, enduring the smoky atmosphere of towns.

Benthamia fragifera—10 feet. Flowers large, yellowish; June. Fruit red, resembling a strawberry. Seeds and cuttings. A wall with a warm aspect.

Berberis Aquifolium—5 to 10 feet. An extremely ornamental species with pinnated leaves, of a shining bright green. The yellow flowers are produced abundantly in April and May, and are succeeded by a profusion of purple berries which are covered with a fine bloom. Seeds and layers.

Berberis aristata—A very ornamental species with

oblong shining leaves, bright yellow flowers, and red berries. Of rapid growth.

Berberis Darwinii—3 to 5 feet. A beautiful shrub densely clothed with small, shining, deep green leaves, and producing an abundance of deep yellow flowers in spring.

Berberis dulcis—3 to 5 feet. A handsome bush with small, entire, deep green leaves, and yellow flowers, in spring. A variety of *B. buxifolia*.

Berberis fascicularis—6 feet. A handsome shrub with very prickly glaucous leaves, and dense racemes of yellow flowers; March to May; succeeded by purple berries. It requires a wall or protection in winter. *B. hybrida* is a hybrid between this and *B. aquifolium*, and is a hardy and ornamental shrub.

Berberis glumacea—1 to 2 feet. A pretty little shrub with pale green pinnated leaves, consisting of about 12 leaflets, and numerous racemes of yellow flowers, succeeded by purple berries.

Berberis trifoliata—4 feet. A handsome species with bluish green leaves, consisting of three leaflets. A warm situation.

Buddlea globosa—12 feet. Branches and under side of the leaves hoary. Flowers small, golden yellow, in globular heads; June and July. Cuttings and layers. Light soil, and a wall with a warm aspect.

Buddlea Lindleyana—6 feet. A valuable shrub for planting against a south wall. Leaves ovate, coarsely toothed, bright green. Flowers in racemes, tubular, violet purple.

Bupleurum fruticosum—5 feet. Leaves oblong, glaucous. Flowers in umbels, small, yellow; July and August. Seeds, cuttings, and layers.

Buxus balcarica—15 feet. A very ornamental species of Box, with larger leaves than the common kind.

Buxus sempervirens (Box)—8 to 15 feet. Of this there are tall and dwarf varieties, having the leaves broad or narrow, plain or variegated with white or yellow. There is likewise a very dwarf variety which is the well-known edging plant. Seeds, cuttings, and layers.

Ceanothus—Very ornamental shrubs, attaining the height of 6 or 10 feet, and flowering abundantly in summer and autumn. The finest species are *C. azureus*, *dentatus*, *papillosus*, and *thyrsifolius*, with flowers of a beautiful blue, *rigidus* with bluish-purple flowers, and *americanus* white. Seeds, layers, and cuttings. A wall or other sheltered situation with protection in winter.

Cerasus Lauro-Cerasus (Common laurel)—15 feet. Too well known to need comment. There is a variety with narrow leaves, also one with variegated foliage. Seeds and layers.

Cerasus lusitanica (Portugal laurel)—15 to 20 feet. One of the most valuable evergreens which we possess. Seeds, cuttings, and layers.

Cistus purpureus—3 to 4 feet. Shoots reddish. Flowers large, reddish-purple, in June and July. Very ornamental. Besides the above, there are many other pretty species which succeed in dry warm situations, with protection in severe frosts. Among these may be mentioned *C. ladaniferus maculatus*, *Corbariensis*, *laurifolius*, *populifolius*, *villosus*, and *algarvensis*. Seeds, cuttings, and layers.

Cotonaster—2 to 5 feet. Very ornamental shrubs with shining leaves, white flowers in summer, and a profusion of red berries, which have a pretty effect in autumn and winter. They are suitable for covering



Drawn by J. W. Rogers

Engraved by J. W. Rogers

1 *Weigela rosea* 2 *Lapageria rosea*

walls, rockwork, and bauks, as well as for planting among other shrubs of low growth; and grafted on the *Cratægus*, they form handsome drooping-headed trees. *C. microphylla* is particularly worthy of cultivation; *C. rotundifolia*, *buxifolia*, and *thymifolia*, are also very desirable species.

Cratægus Pyracantha—6 to 8 feet. Flowers, in large corymbs, white. Fruit bright red; very ornamental in autumn.

Daphne Cneorum—1 foot. Trailing. Leaves small, lanceolate. Flowers small, but numerous; very sweet-scented; rose-coloured or white; April and May, and frequently again in autumn. Highly ornamental. There is a variety with variegated leaves. Layers, and grafting on *D. Laureola*. Peat-soil, and a shady situation.

Daphne Laureola (Spurge Laurel)—3 feet. Leaves obovate-lanceolate, shining, deep green. Flowers greenish-yellow, sweet-scented; January to March. A very ornamental round bush. Seeds. Shady situation, and peat soil.

Daphne neapolitana—A very ornamental variety of *D. collina*, with very fragrant purple flowers.

Daphne pontica—3 to 4 feet. Flowers numerous, yellowish, sweet-scented; March to May. Peat soil, and a sheltered situation.

Erica—Several species of this beautiful genus succeed in the open ground, forming very ornamental edgings, masses, and detached bushes. Among these are:—*E. cinerea*, *tetralix*, and *vagans*, $\frac{1}{2}$ to 1 foot, with red or white flowers; *E. stricta*, *carnea*, or *herbacea*, pale red; *E. vulgaris*, 1 to 3 feet, red, purple, or white; *E. mediterranea*, 4 feet, red; and *E. australis*, 5 to 7 feet, red. Layers, and cuttings of the young shoots in sand, or sandy peat, under a bell-glass. Sandy peat.

Eriobotrya japonica—6 to 10 feet. Very ornamental by its large, lanceolate, rustie-looking leaves. Grafting. Warm situation.

Escallonia floribunda—6 to 8 feet. Leaves oblong, shining. Flowers numerous, and very ornamental, white; July to September. Cuttings. A south wall.

Escallonia macrantha—6 to 8 feet. Highly ornamental by its shining, deep green leaves, and splendid reddish purple flowers. Cuttings. Sheltered situation.

Escallonia rubra—4 to 6 feet. A very ornamental species, with shining leaves and pendulous red flowers; July to September. Cuttings. Sheltered situation.

Euonymus japonicus variegatus—10 feet. Ornamental by its foliage, which is edged with white. A wall with a warm aspect.

Fontanesia phillyræoides—6 to 10 feet. A very ornamental phillyrea-like shrub, requiring a warm situation and protection in winter. Cuttings and layers.

Garrya elliptica—6 to 12 feet. Leaves elliptic, shining, dark green. Flowers numerous and ornamental; greenish-yellow, in long pendulous catkins; November to March. Layers and cuttings under a hand-glass.

Gaultheria procumbens— $\frac{1}{2}$ foot. Leaves oval, shining. Flowers white; July to September; succeeded by scarlet berries. Seeds and division. Peat soil. A very ornamental little plant.

Gaultheria Shallon—2 feet. Proeumbent. Flowers white, tinged with red; May. Berries purple. Layers. Peat soil.

Helianthemum vulgare with yellow flowers in loose racemes; *H. coccineum* crimson; *macranthum* white; *hyssopifolium* saffron; *croceum* yellow; *venustum* red; and numerous other species and varieties are very orna-

mental trailing shrubs, flowering in June and July, and suitable for planting on rockwork, or in the front of borders. Seeds and cuttings.

Hypericum calycinum—1 foot. Creeping. Leaves large, ovate, dark green, sprinkled with transparent dots. Flowers large, bright yellow; June to September. Suitable for rockwork, and covering ground under trees. Division.

Illicium floridanum—4 to 6 feet. Flowers numerous, brownish-red, with a strong anise smell; April and May. Layers and cuttings. Warm situation, and protection in winter.

Kalmia—The most ornamental species of this genus is *K. latifolia*, a beautiful shrub growing to the height of 5 or 10 feet, and producing flesh-coloured flowers in June; *K. angustifolia* and *glauca* are also pretty dwarf evergreens, with red flowers. *Kalmias* require to be planted in sandy peat, or heath mould; but they will also succeed well in a light loam mixed with leaf-mould. They should have a moist situation, screened from strong sun, and sheltered from keen winds. Propagation is effected by seeds, cuttings, and layers, in the same way as the rhododendron.

Laurus nobilis (Sweet Bay)—15 to 30 feet. Leaves lanceolate, smooth, dark olive green, sweet-scented. Flowers numerous, yellowish; May; succeeded by dark purple berries. There are varieties with waved, narrow, broad, and variegated leaves. Seeds on a hotbed, and cuttings.

Lavandula Spica (Lavender)—3 feet. Deserving a place in every garden, for the fragrance of its leaves and flowers. Cuttings under a hand-glass, and division.

Ledum latifolium—4 feet, and *L. palustre*, are ornamental little evergreens, with small white flowers. Layers. Peat soil.

Ligustrum japonicum—6 to 10 feet. A pretty species of Privet, with large, shining leaves, and numerous white flowers. Seeds and grafting.

Ligustrum vulgare sempervirens—6 to 10 feet. An evergreen variety of the common Privet, excellent for hedges, and planting among other shrubs.

Menziesia polifolia—1 to 2 feet. Leaves small, elliptic, white beneath. Flowers white, or purple; June to September. Cuttings and layers. Peat soil. A pretty little bush.

Pernettya mucronata—2 to 3 feet. A pretty little shrub, with shining, dark green leaves, and drooping white flowers; May. Peat.

Phillyrea angustifolia, *latifolia*, and *media*—Growing to the height of from 10 to 15 feet, deserve a place in every shrubbery and pleasure-ground, on account of their beautiful shining, dark green foliage. Cuttings and layers.

Phlomis fruticosa—3 feet. A low bush, with hoary leaves and bright yellow flowers; June and July. Seeds and cuttings.

Photinia serratula—6 to 12 feet. Leaves large, oblong, shining. Flowers in large corymbs, white; April and May. Cuttings, and more commonly grafting on the hawthorn or quince. A wall or other warm situation.

Prinos glaber—3 to 5 feet. A dense bush, ornamental by its shining, lanceolate leaves. Layers and cuttings in heat. Peat.

Rhamnus Alaternus—10 to 15 feet. Leaves oval, shining. There are several varieties, but the most remarkable are *angustifolius*, with narrow leaves, and

R. A. foliis argenteis, the foliage of which is much variegated with white. Layers and cuttings. Of rapid growth, and very ornamental.

Rhododendron.—The value for decorative purposes of this splendid genus is so well known, as to render comment on its merits superfluous; it is enough to say, that common as the rhododendron is in gardens, it is not half so generally cultivated as it ought to be. The hardy varieties, which are endless, have chiefly sprung from *ponticum*, *caucasicum*, *cataubienae*, and *maximum*, crossed with the Indian species *arborcum*, and are now cultivated almost to the exclusion of the original species. Of late years, by the exertions of that distinguished traveller and botanist, Dr. Joseph Hooker, numerous fine rhododendrons have been introduced from Sikkim and Bhotan, and they will doubtless give rise to still further variations.

The rhododendron, to succeed well, requires to be grown in a light rich soil, readily permeable to moisture, but free from stagnant water; a sandy peat, or heath-mould is the best; but a light, rich, sandy loam, mixed with leaf-mould and rotten turf, will answer exceedingly well. Chalk is wholly unsuitable; and in all soils of an adhesive nature, the delicate fibrous roots soon perish. If the soil is naturally unfitted for the growth of the plant, and peat cannot be had, a compost will have to be prepared. This may consist of equal parts of leaf-mould, or other thoroughly decomposed vegetable matter, rotten turf, sandy loam, and sand—the whole thoroughly incorporated, laid in a heap for some months previous to use, and frequently turned. Where plenty of leaf mould is at command, a greater proportion of that substance may be employed, especially when the loam is not of a very light nature, in which case also more sand should be added.

The situation should be moist, and if shady, all the better; but it ought not to be overhung by trees, for these would prove injurious by the drip from their leaves, and by the incursions of their roots, which would not only impoverish the soil, but absorb moisture in enormous quantities to supply the evaporation from the leaves with which they are in connection, and this at the very time when the plants are in the greatest danger of suffering from dryness at the roots—a state which is particularly to be guarded against with this class of plants.

In preparing beds for American plants in retentive soils, it is of great importance to secure proper drainage, in the first instance; for, though requiring abundance of moisture, their roots cannot long survive when this becomes stagnant. Should the natural soil consist of peat or heath-mould, the ground will merely require to be trenched, a little well-decomposed cow-dung, or any light rich compost being mixed up with it in the operation, and if deficient in sand, a due proportion of this substance must also be added. Where the natural soil is not suitable, it ought to be dug out in September or October, to the depth of at least 18 inches, or better, 2 feet, and the subsoil loosened to an equal depth. The peat or compost having been chopped up, should be filled in, so that after sinking, it may be no higher than the adjoining ground; indeed, in dry situations, it is advantageous to sink it below that level, in order to secure a better supply of moisture, and for a like reason, it is not advisable to elevate, to any considerable extent, the middle of the beds above the sides.

Propagation is effected by seeds, cuttings, and layers, and by grafting. The seeds should be sown in February or March, in gentle heat, or in April, in a cold frame,

using in either case boxes or pans of sandy peat, with a layer of fine sandy soil at top. The soil having been made smooth and watered, the seeds should be scattered thinly, pressed in, and very slightly covered with silver sand. The pans may then be removed to a warm pit or cold frame, where attention should be paid to shading from sun, and keeping the soil moist by watering through a very fine rose. To obviate the necessity of frequent watering, a little moss may be placed over the soil, but this covering will have to be removed when vegetation commences. When the seedlings can be laid hold of, they should be pricked out 3 inches apart, shading and keeping close till they have again struck root. Afterwards, the young plants should be gradually exposed more and more to the air, taking care, however, to keep the soil in which they are growing always moist, and to protect from frost and strong sun.

Cuttings of the young wood partially ripened at the base strike in peat, covered with a layer of sand, into which they should be inserted. The cuttings ought then to be covered with hand or bell-glasses, shut up in a frame, and kept shaded and moist. When struck, air should be gradually admitted. The process of rooting will take place more rapidly on a gentle bottom-heat, to which the cuttings may be removed as soon as they have formed a callus.

Layering may be effected in spring or autumn, but is a slow process. Grafting is a more speedy mode of increasing established varieties; and when both stock and scion are equally vigorous, answers as well as any other. It is best performed in August or September, when the young shoots have ripened, but may also be practised in spring. Side-grafting is the mode generally preferred; but where the stock is small, wedge-grafting may be adopted. After the operation, the plants should be shut up in a frame till the graft has taken. Budding and inarching are also convenient modes of propagating this plant.

When beds of rhododendrons are becoming overcrowded, or exhibit signs of the soil being exhausted, the plants should be taken up in autumn or spring and replanted, the soil being wholly or partially renewed; but to obviate the necessity of having recourse to this operation too frequently, a compost of well-decomposed cow-dung and leaf-mould should be forked in every year. When seed is not to be saved, the seed-vessels should be removed when the flowers have faded.

Rosmarinus officinalis (Rosemary)—3 to 4 feet. Ornamental, by its linear dark green leaves. Cuttings, layers, and division.

Ruscus aculeatus—2 feet. Flowers small, white, springing from the surface of the leaves, which are of a deep green. Berries large, red. Suitable for planting under trees, and in other shady situations, where it is very ornamental. Division.

Ruscus racemosus—3 to 4 feet. A handsome little evergreen, with bright green shoots and leaves.

Spartium junceum (Spanish Broom)—6 to 10 feet. Shoots dark green. Leaves few, lanceolate. Flowers, large, deep yellow, sweet-scented; July to September. There is a variety with double flowers. Very ornamental. Seeds and cuttings.

Tecoma gallica—5 to 10 feet. An almost evergreen shrub, with small, imbricated leaves, and small pink flowers in summer and autumn. Cuttings. Deep, moist, light soil. Suitable for planting by the side of ornamental water, and near the sea.

Ulex europæus (Furze)—The double variety of this is very ornamental by its numerous yellow flowers in spring. Cuttings.

Viburnum Tinus (Laurustinus)—8 to 10 feet. Flowers in corymbs, small, but very numerous and ornamental; white, tinged with red on the outside; throughout the winter and spring. There are several varieties differing in the foliage. Slips, layers, and cuttings, in autumn.

Vinca major—2 to 3 feet. Trailing. Leaves ovate, dark green. Flowers salver-shaped; blue; May to September. There is a variety with variegated leaves. Division, layers, and cuttings. Suitable for rockwork and planting under trees.

Vinca minor—Trailing. Flowers blue, red, or white, in different varieties; March to September. There is also a variety with variegated leaves.

Vaccinium Vitis-Idæa—1 foot. Ornamental by its shining leaves, small bell-shaped pink flowers in summer, and numerous red berries in autumn. Sandy peat, kept moist, and a shady situation.

Yucca gloriosa—2 to 5 feet. Leaves long, ensiform, dark green. Flowers extremely numerous, in panicles, bell-shaped, pendulous, white; July to September.

Yucca glaucescens—Leaves 2 feet in length, numerous, lanceolate, glaucous. Flowers numerous, white; August and September.

Yucca filamentosa—1 foot. Leaves radical, with white threads hanging from the margins. Flowers borne on a flower-stem 3 feet or more in height, large and very numerous, white; September. Suckers. Deep light soil. Very ornamental plants for lawns, borders, and rockwork.

V.—CLIMBERS.

Ampelopsis hederacea—syn. *Hedera quinquefolia*, L. (Virginian Creeper)—30 to 50 feet. Leaves digitate, shining, green, becoming deep crimson in autumn. A valuable climber, of rapid growth. Cuttings and layers.

Aristolochia Sipho—15 to 30 feet. Leaves very large, cordate. Flowers resembling a siphon in shape; brown and yellow; June and July. Suckers and layers. A warm situation.

Bignonia capreolata—15 feet. Flowers numerous, reddish-yellow; June and July. A highly ornamental climber for training against a wall. Cuttings of roots and shoots. Protection to the root in winter.

Bridgesia spicata, an evergreen climber, with handsome oval leaves, and numerous spikes of flowers, which are tipped with reddish pink, like those of the *Laurustinus* before expanding, may be used instead of ivy for covering walls.

Clematis alpina—5 to 8 feet. A very ornamental little plant, with blue flowers; June and July. There is a variety, *C. sibirica*, with white flowers. Layers.

Clematis cerulea—syn. *C. azurea*—10 feet. Flowers large and numerous, of a beautiful blue; May and June. Very ornamental. Layers.

Clematis cirrhosa—5 to 10 feet. Leaves evergreen. Flowers pendulous, bell-shaped, greenish-white; winter and spring. Layers and cuttings. A south wall.

Clematis Flammula—20 feet. Flowers numerous, white, very odoriferous; July to September. There are several varieties; among which may be mentioned *C. rubella*, with larger flowers, which are reddish on the outside.

Clematis florida flore pleno—10 feet. Flowers large, and very double, white; June to October. Layers.

Very ornamental, but requiring a wall with a warm aspect in most situations. *C. bicolor* or *Sieboldii* is a highly ornamental variety, the flowers of which are white, with a violet purple centre.

Clematis Hendersonii—8 to 12 feet. Flowers very numerous, campanulate, bluish-purple; June to September. Layers. Highly ornamental.

Clematis lanuginosa—10 feet. Flowers large and numerous, azure, very ornamental.

Clematis montana—20 to 30 feet. Flowers numerous, white; May. A very ornamental species.

Clematis Vitalba—30 feet. Flowers white; August and September. Of rapid growth, and suitable for covering unsightly objects.

Clematis Viticella—10 to 15 feet. Flowers blue, purple, red, double blue, and double purple; July to September. Very ornamental.

Hedera Helix (Ivy).—The value of this as an evergreen climber is so well known, as to render comment on its merits superfluous. The most remarkable varieties are those in which the foliage is variegated with white and yellow, and the Irish ivy, of more rapid growth, and having larger leaves than the common kind. Cuttings and layers.

Jasminum nudiflorum—Flowers very numerous, bright yellow, scentless, appearing in winter before the leaves. Cuttings and layers. May be grown either as a bush, or against a wall.

Jasminum officinale (Common Jasmine)—30 feet. A well-known climber, with delightfully fragrant white flowers; July to September. Cuttings and layers. There is a variety with variegated leaves.

Jasminum revolutum—12 feet. Leaves evergreen. Flowers yellow, very sweet-scented; June to October. Protection in severe winters.

Lonicera confusa—10 feet. Flowers pure white, changing to yellow, very sweet-scented; June and July. Cuttings and layers. Rich soil, and a wall.

Lonicera flava—10 feet. Flowers numerous, bright yellow, very odoriferous; June and July. Wall with a warm aspect.

Lonicera japonica—20 feet. Flowers numerous and very fragrant, white and red; throughout the summer. Very ornamental.

Lonicera Periclymenum (Common Honeysuckle)—20 feet. Flowers yellow, or red, according to the variety, sweet-scented; June and July. Cuttings and layers.

Lonicera sempervirens—10 feet. Leaves evergreen. Flowers bright red, or fine yellow within, scentless; May to August.

Lycium europæum—20 to 30 feet. Flowers numerous, pale purple; May to August. Fruit bright red. Of rapid growth, and suitable for covering walls, banks, and training up stakes.

L. barbarum and *chinense* resemble the above, but do not attain so large a size. Cuttings.

Passiflora cærulea—15 to 30 feet. Leaves palmate. Flowers white, with a blue crown; July to October. A highly ornamental plant, of rapid growth, but requiring a wall with a warm aspect, and slight protection in winter. Cuttings and layers.

Periploca græca—15 to 25 feet. Flowers brownish-purple, velvety; July and August. Cuttings and layers. A valuable climber; but the flowers exhale a foetid odour.

Tecoma radicans—20 to 30 feet. Flowers large and numerous, orange; August and September. Cuttings

of the roots, layers, and cuttings in heat. A highly ornamental plant, requiring a wall with a warm aspect. There is a variety, *T. radicans major*, with scarlet flowers, and another with purple flowers.

Vitis Labrusca, cordifolia, riparia—American species of vines—suitable for covering arbours, and forming festoons along chains.

Wistaria chinensis.—Few plants have a more magnificent effect than this remarkable climber, when covered with its long racemes of pale blue flowers, in May and June. In England it succeeds well, trained as a standard, or planted against a pillar or trellis; but to attain its full development, it should have a wall with a warm aspect. The plant prefers a rather light soil, and is propagated by layers in summer, cuttings under glass, and whip-grafting. There is a variety with white flowers, which may be propagated by layers or cuttings, or by grafting on the roots of the other kind.

VI.—HARDY AND HALF-HARDY ANNUALS.

These constitute a numerous class, but a large proportion of them, from their straggling growth and great development of leaves, as compared with that of flowers, have a weedy appearance, and are consequently but ill suited for the decoration of the flower garden; accordingly, annuals have been very generally supplanted by geraniums, verbenas, petunias, and other bedding plants. Many of them, however, bloom profusely, combine in the flower great brilliancy of colour with elegance of form, and when properly managed are not liable to the above objections; some form pretty edgings, and others are suitable for massing, for covering rockwork, and for training upon fences. In the following select list, a few perennials are included, which, from flowering the first year, may be treated like annuals:—

Bartonia aurea—18 inches. Habit branching and straggling. Flowers large, bright yellow, throughout the summer. Suitable for borders.

Calandrinia umbellata—6 inches. Flowers in umbels, bright rosy purple, rather small, but numerous, pretty, and of long continuance. Suitable for beds and rockwork. It should be sown where it is to remain.

Calliopsis (Coreopsis) Drummondii—12 to 18 inches. Flowers large, yellow and brown, numerous, and pretty; May to August, by sowing at different times.

Calliopsis (Coreopsis) tinctoria—24 inches. Flowers rather large, yellow, with a brown centre, produced in long succession. There are dwarf varieties suitable for small beds. *C. coronata* and *Burridgei* are also very desirable sorts.

Campanula Lorei—12 inches. Flowers large, blue, numerous, and of long continuance. There is a variety with white flowers.

Campanula pentagonia—9 inches. Flowers pale blue, suitable for small beds and borders. There is a variety with white flowers.

Centranthus macrosiphon—15 inches. Flowers in dense corymbs, bright red. There are dwarf varieties with pale rose and white flowers.

Clarkia pulchella—12 to 18 inches. Flowers rose-coloured, very numerous and pretty. One of the most ornamental annuals for beds and borders. There is a variety with white flowers, and one in which these are rosy-crimson edged with white.

Cochlearia acaulis—3 inches. Flowers numerous, pale lilac, borne singly on scapes. Suitable for the edgings of beds and rockwork; if sown in autumn, it will flower throughout the winter under glass.

Collinsia bicolor—9 inches. Habit erect. Flowers purple and white, very numerous and pretty. There is a variety with white flowers, and another called *multicolor*, with white, lilac, and purple flowers.

Collinsia grandiflora—9 inches. Flowers rather large, lilac and blue, numerous and pretty.

Collomia coccinea—12 inches. Flowers small but numerous, bright scarlet.

Convolvulus tricolor (Convolvulus minor)—12 inches. Flowers large and numerous, blue, white, and yellow. There are varieties with dark purple, white, and striped flowers.

Delphinium Ajacis (Rocket Larkspur)—12 to 24 inches. Of this well-known plant, there are varieties with white, pink, red, purple, blue, and variegated flowers, all of which may be employed with good effect in beds and borders.

Dianthus sinensis (Indian Pink)—Biennial—9 to 12 inches. Flowers numerous and pretty, and, according to the variety, of various colours, as purple, red, pink, white, striped, or spotted. Suitable for beds, mixed borders, and rockwork.

Erysimum Perofskianum—18 inches. Flowers numerous, orange, of long duration, and very ornamental.

Eschscholtzia crocea—Perennial—12 inches. Flowers large, deep orange, numerous, and produced in long succession.

Eucharidium concinnum—9 to 12 inches. Flowers numerous, in form like those of *Clarkia pulchella*; dark red.

Eucharidium grandiflorum—9 to 12 inches. Flowers numerous, rosy purple, very ornamental. Well adapted for small beds and front lines.

Eutoca viscida—Flowers numerous, deep blue; June to August. A very pretty annual for beds and pot culture.

Gilia achillæfolia—15 inches. Habit erect. Flowers dark blue. It requires to be sown thickly.

Gilia tricolor—12 inches. Flowers blue and purple, with a yellow eye, but varying much in colour, of long continuance. It makes a pretty bed. There is a variety with almost white flowers.

Godetia Lindleyana—12 inches. Flowers large, pale rose, with a crimson blotch in the centre of each petal.

Godetia rubicunda—18 inches. Flowers rose, with a red centre, numerous, and very ornamental.

Hibiscus africanus—18 inches. Flowers large, straw coloured, with a dark crimson centre; produced in long succession.

Iberis umbellata (Candytuft)—Flowers white, crimson, or purple, very numerous. Sow where it is to remain, or in pots for planting out with a ball.

Kongia maritima—syn. *Alyssum maritimum*.—8 inches. Flowers small, white, sweet-scented; July to October. Well adapted for the edgings of beds.

Lathyrus odoratus (Sweet Pea)—4 feet. Flowers purple, rose, white, or variegated; sweet-scented.

Leptosiphon androsaceus—9 inches. Flowers small,

varying from rose-coloured to blue; of long duration. There is a variety with white, and another with pale yellow flowers.

Leptosiphon aureus—9 inches. Flowers small, golden yellow, produced in great abundance. Suitable for the edgings of beds and rockwork.

Leptosiphon densiflorus—9 to 12 inches. Habit spreading. Flowers large, pale purple, in numerous clusters, very pretty, and of long duration. There is a variety with white flowers.

Limnanthes alba—6 inches. Habit erect. Flowers white, small, but numerous, and very ornamental, especially when the seed is sown in autumn.

Limnanthes Douglasii—6 inches. Flowers yellow and white, numerous, and ornamental.

Linaria macroura—Perennial—12 inches. Flowers numerous, pale yellow.

Linum grandiflorum rubrum—Perennial—9 to 12 inches. Flowers large, of a brilliant crimson, produced throughout the summer. A beautiful plant for massing and pot culture. It requires a rich light soil. Sow in April, or in heat in March for planting out in May. The seeds should be soaked in water for some hours previous to sowing, in order to hasten their germination.

Lupinus Hartwegii—18 to 24 inches. Flowers blue and white, numerous, and of long duration. Very desirable for large beds. There is a variety with white flowers.

Lupinus Moritzianus—30 inches. Flowers in long spikes, very dark blue and white; produced in great abundance. Suitable for borders.

Lupinus nanus—9 to 12 inches. Flowers small, blue and white, of long continuance. There is a variety with white flowers.

Malcolmia maritima (Virginian Stock)—6 inches. Flowers lilac or red, numerous, and produced in succession. Suitable for small beds or edgings, and by sowing at various periods may be had in flower throughout the spring, summer, and autumn. There is a variety with white flowers, and another, *bicolor*, with white and lilac flowers.

Malope grandiflora—24 inches. Flowers large, dark crimson, numerous, showy, and produced in succession. Suitable for large beds and borders.

Monolopia californica—6 inches. Flowers small, but extremely numerous, deep yellow. Makes a neat mass.

Nemophila atomaria—6 inches. Habit spreading. Flowers small, white, spotted with dark brown, numerous.

Nemophila insignis—6 inches. Habit spreading. Flowers azure blue, numerous, and very pretty. A beautiful annual, suitable for beds, edgings, and pot culture. It has given rise to *N. insignis marginata*, flowers blue, edged with white; *N. insignis alba*, white, and several other varieties.

Nemophila maculata—6 inches. Flowers large, white, with a violet blotch in the centre of each petal.

Platystemon californicus—9 to 12 inches. Habit spreading. Flowers straw-coloured, sweet-scented, numerous and pretty.

Rescda odorata (Mignonette)—9 inches. Flowers deliciously fragrant. For blooming in winter and spring, sow in August and September, in pots filled with loam mixed with about one-fourth leaf-mould, and protect from frost and heavy rain in a cold frame, giving plenty of air when the weather is favourable. For succession, sowings may be made in February and March on a slight

bottom heat, and in the open ground throughout the summer.

Saponaria calabrica—9 inches. Flowers pink, small, but numerous, and highly ornamental for beds, edgings, and rockwork.

Schizopetalon Walkeri—9 to 12 inches. Flowers small, but numerous, white, much fringed, sweet-scented at night.

Specularia Speculum (Venus's Looking-glass)—8 inches. Flowers numerous, blue and white. Suitable for edgings.

Sphenogyne speciosa—12 to 15 inches. Flowers large, orange yellow, with a red disk, numerous, and of long duration.

Tagetes signata—18 inches. Flowers numerous, and produced in long succession, yellow spotted with brown.

Tropæolum majus (Common Nasturtium)—6 feet. Flowers orange. Suitable for covering palings, stakes, &c. There are varieties with crimson, spotted, and yellow flowers.

Valeriana (Fedia) cornucopiae.—Flowers numerous, purplish, producing an ornamental effect in masses.

Viscaria cæli-rosa—12 inches. Habit spreading. Flowers bright rose, numerous, and pretty.

Viscaria oculata—9 to 12 inches. Flowers numerous, rose-coloured, with a dark purple eye, pretty, and of long continuance. There is a variety with white flowers and a dark eye.

HALF-HARDY ANNUALS.

Abronia umbellata—6 inches. Habit trailing. Flowers rosy-lilac, in umbels, sweet-scented, and of long continuance.

Ageratum cælestinum nanum—Perennial—12 to 18 inches. Flowers bright blue; July to November. It may easily be propagated by cuttings as well as by seeds.

Ageratum mexicanum—15 inches. Flowers pale blue, very ornamental. Like the preceding, it may be propagated by cuttings.

Alonsoa Warscewiczii—Perennial—18 inches. Flowers bright scarlet, in spikes. Suitable for pot culture. Sow in heat in February or March.

Anagallis indica, blue; *Monelli*, blue; *Phillipsii*, bright blue; *grandiflora cærulea*, blue; *Parksii*, scarlet, and several other varieties of *Anagallis*, produce a fine effect in masses. They may be sown in March and planted out in May; but for early flowering they should be sown in September and pricked out into small pots, which must be kept in a cold frame during the winter. Thus they may be had in flower from May to October. Propagation may also be effected by cuttings on a moderate hotbed.

Aster sinensis (China Aster)—12 to 18 inches. Flowers large, abundant, very pretty, exhibiting in the numerous varieties every shade of colour except yellow, and a great diversity of marking. Sow in heat in March and April, and plant out as soon as the buds begin to form. The chrysanthemum and pæony flowered varieties are particularly worthy of cultivation for the size, colour, and abundance of their flowers.

Balsamina hortensis (Garden Balsam)—12 to 24 inches. Flowers large, numerous, and in the improved varieties double, white, purple, crimson, yellow, or variegated; June to October. Sow in March or April in pots plunged in a gentle hotbed; and when the young plants have made two leaves, pot off into 3-inch pots, and as soon as again well established, gradually harden off

for planting out in the end of May. When large specimens in pots are required, the plants should be removed to a cold pit, shifted whenever the roots reach the sides of the pots, using rich soil, such as a compost of turfy loam, rotten dung, and leaf-mould, keeping near the glass till the blooms begin to expand, when the plants may be removed to the greenhouse or conservatory.

Brachycome iberidifolia—9 to 12 inches. Flowers large, resembling those of a *Cineraria*, blue, numerous, and produced in long succession.

Chanostoma fastigiatum—9 inches. Flowers bright rose, pretty, and of long continuance.

Clintonia pulchella—4 inches. Flowers small, blue, with a white centre spotted with yellow, produced in abundance. A very pretty plant, either for beds, vases, or pot culture. It requires to be sown in light soil, mixed with leaf mould, the seeds being merely pressed in.

Cobæa scandens—Perennial, 20 to 30 feet. Habit climbing. Flowers large, purplish. Well adapted, from its rapid growth, for covering walls or other objects which it may be desirable to hide. It is propagated by seed, also by cuttings and layers.

Gaillardia Drummondii, syn. *G. picta*—Perennial, 12 to 15 inches. Flowers crimson, with a yellow margin, large, and very showy. There are several fine varieties.

Helichrysium bracteatum—2 to 3 feet. Flowers large, golden yellow; June to October. Suitable for patches in borders. There is a dwarf variety with white, and another with yellow flowers.

Helichrysium macranthum—18 to 24 inches. Flowers large, rose-coloured, numerous and of long continuance. There are several varieties presenting various shades of red. The flowers of this and the preceding species, if dried, will preserve their colour for years, for which reason they are termed *everlastings*.

Ipomœa hederacea—6 feet. Habit climbing. Flowers bright blue, numerous, and very ornamental. There are several varieties.

Ipomœa purpurea (*Convolvulus major*).—Habit climbing. Flowers large, purple on the inside, purple and white on the exterior. There are varieties with white, blue, rose, and striped flowers. Suitable for covering walls, fences, &c.

Lobelia Erinus—4 to 6 inches. Flowers small, light blue, very numerous, and produced throughout the summer. It has given rise to several varieties, among which may be mentioned *L. Erinus speciosa*, with bright blue flowers and a white eye, and *alba* with nearly white flowers.

Lobelia ramosa—12 inches. Habit branching and spreading. Flowers large, deep blue, numerous, and of long duration. It requires a light or peaty soil, and to be sown or planted out rather thickly.

Lophospermum scandens—Perennial—6 feet. Habit climbing. Flowers large, numerous, rosy purple, very showy. Suitable for covering walls, &c. It requires a warm situation.

Mathiola annua and *græca* (Ten-weeks, Wallflower-leaved, and Intermediate Stocks)—12 to 18 inches. Of these there are many highly ornamental varieties, presenting various shades of purple, blue, lilac, red, brown, and white, and flowering, according to the time of sowing, from May till October, or later. For early flowering sow about the end of August or beginning of September, and as soon as the plants are strong enough, pot in 4 or 5-inch pots, placing three or four in each. In November, or at the approach of frost, remove to a cold frame; give plenty of air whenever the weather is favourable;

and plant out in April, or as soon as all danger of severe frost is past. A sowing made on a gentle hotbed in the end of February or beginning of March, will flower nearly as early. For succession, seed may be sown in heat in the beginning of April, or in the open ground in March; and in April, May, and June, for late flowering. The sowings should be made in rich loamy soil, and if in pots, some peat should be mixed with it.

Mesembryanthemum tricolor—4 inches. Flowers large, rose-coloured and white, very pretty, numerous, and of long continuance.

Oxalis rosea—Perennial—6 inches. Flowers rose-coloured, numerous, and very pretty; May to July. It succeeds best in light soil mixed with leaf-mould. Suitable for edgings.

Phlox Drummondii—Perennial—15 inches. Flowers numerous, of various colours, as crimson, crimson with a white eye, purple, white, or white with a purple eye. A beautiful plant for beds, and the flowers remain long in perfection. It may be propagated by seeds and cuttings. Sow in the end of March; pot off when the seedlings have made three or four leaves; and when again established, harden off, and plant out in the end of May.

Portulaca.—In warm seasons some of the varieties of this genus will succeed out of doors, if planted in a warm situation. The best are:—*P. grandiflora*, bright rosy purple, with a white centre; *P. grandiflora alba*, pure white, frequently streaked with red; *P. Thellusoni*, scarlet, with a white centre; and *P. Thorburni*, orange. Sow about the middle of March in pots of loamy soil, mixed with cow dung, and plunge in a moderate hotbed. Pot off as soon as the seedlings are strong enough, and when well established, place near the glass in a pit; shift into larger pots when necessary, and plant out in June.

Rhodanthe Manglesii—12 inches. Flowers deep rose, with a yellow centre, numerous, of long continuance, and very ornamental. Suitable for beds and pot culture.

Salpiglossis sinuata—18 inches. Flowers large and very ornamental; purple, scarlet, yellow, and streaked, according to the variety; July and August.

Schizanthus pinnatus—18 to 24 inches. Flowers lilac, spotted with purple and yellow, numerous and pretty.

Schizanthus retusus—18 to 24 inches. Flowers deep rose and yellow, veined with purple, very showy. There is a dwarf variety; also one with white and yellow flowers.

Senecio elegans—18 inches. Flowers small, according to the variety, crimson, pink or white, single or double, of long continuance.

Tagetes erecta nana (Dwarf African Marigold).—Flowers large, deep yellow, very early.

Tagetes patula (French Marigold)—9 to 18 inches. Of this there are several varieties, some of which are very dwarf. The flowers are single or double, yellow, orange, or variegated with brown.

Tropæolum peregrinum—8 to 12 feet. Habit climbing. Flowers canary yellow, with the two upper petals fringed, numerous, and pretty.

Zinnia elegans—2 feet. Flowers large, bright scarlet, with a dark purple disc, numerous, and very ornamental. There are varieties presenting various shades of colour, from purple to white.

Culture.—There are three principal periods at which annuals are sown in the open ground; namely, in autumn for early flowering, in

spring for a summer display, and in May and June for a late bloom.

The most proper time for making the autumn sowing depends on the character of the season; in cold backward autumns it is advisable to sow earlier than in those which are warm and favourable to vegetation, otherwise the seedlings from being young and tender are apt to be cut off by frost. In general the operation is best performed about the middle of September, but in unfavourable years it is better to sow about the end of August. If warm weather should afterwards ensue, and the plants are becoming too forward in consequence, their growth may be checked by transplanting. It is only the hardiest annuals that will survive the winter without the protection of a frame; among such are *Bartonia*, *Clarkia*, *Collinsia*, *Delphinium*, *Erysimum*, *Eschscholtzia*, *Eutoca*, *Gilia*, *Godetia*, *Iberis*, *Koniga*, *Leptosiphon*, *Malcomia*, *Nemophila*, *Silene*, and *Valeriana*.

A situation sheltered from strong winds, but well exposed to the light, should be chosen for the autumn sowing; soil of a rather light and dry nature is also to be preferred. The seed should be scattered thinly, and the seedlings thinned out when strong enough; beyond this nothing further will be required till the beginning of March, when they may be transplanted into the situations where they are intended to bloom; in severe weather, however, some protection may be given.

The spring sowing may be made any time from the middle of March to the middle of April; but in order to insure a better succession of bloom during the summer, seed may be sown at both these periods. All the hardy annuals are eligible for these sowings.

In order to secure a display during the autumnal months, sow in May or in the beginning of June, and with a similar object in view the half-hardy annuals may also be sown in the open ground at the same times; otherwise they should be sown on a moderate hotbed, or in a warm pit, in March or April.

With few exceptions annuals require to be sown in common garden soil; for in rich ground they are apt to grow tall and straggling, producing leaves rather than flowers. Hardy annuals may either be sown where they are to remain, or in nursery beds for transplantation, a plan which may be advantageously adopted when it is desired to occupy the ground for as short a period as possible.

Some kinds, however do not succeed so well when thus treated; but the difficulty may be overcome by sowing thinly in pots, and transplanting with balls. Indeed it is always advisable to make a sowing in pots, as vacancies can then be filled up even when the plants are coming into flower. Instead of in pots some sow upon turves, covered with a thin layer of mould, and having the grassy side downwards. In either way it would be possible, by making successional sowings, and replacing the former as soon as the flowers began to fade, to keep up a show of bloom throughout the summer and autumn. Previous to sowing, the ground ought to be well dug, slightly trodden or beaten to prevent it from sinking, and afterwards raked fine. The seeds should then be scattered thinly and covered with fine mould to a greater or less depth according to their size, those which are very small requiring only a very light covering of earth.

Half-hardy annuals require to be sown in March and April, either in pans in a pit where a temperature of 55° by night and 70° or 75° by day is maintained, or on a moderate hotbed. When the seedlings make their appearance above ground, air must be given in favourable weather to prevent them from becoming drawn up; and shading from strong sun will also be necessary. When they have made a few leaves they should be thinned out, or transplanted to another hotbed, or into small pots. Afterwards they should be gradually hardened off, and planted out about the middle of May if the weather is favourable. At that period seeds may also be sown in warm spots in the open ground for late flowering.

The other culture merely consists in thinning out the plants according to their growth and the richness of the soil, keeping free of weeds, cutting off straggling branches, supporting such kinds as require it by introducing small stakes amongst them, so that the supports may be hidden by the foliage, training climbing annuals, watering, and removing withered flowers.

VII.—HARDY AND HALF-HARDY BIENNIALS.

Campanula Medium (Canterbury Bells)—2 feet. Flowers numerous, from June to August, single or double, blue, violet, or white, according to the variety. Sow in April, and plant out early in autumn.

Digitalis purpurea—3 feet. Flowers numerous, purple or white; June to August. Sow as soon as the seeds are ripe. *D. ferruginea*, with brownish flowers, is likewise an ornamental species.

Hedysarum coronarium (French Honeysuckle)—3 feet. Flowers pretty, scarlet or white, according to the variety; June and July. Sow in April or May in light soil, and plant out early in autumn.

Humea elegans—3 to 5 feet. Flowers in large, graceful panicles, brownish, red, very ornamental; June to October or November. Sow in June or July in pans of light rich soil, in a warm pit or greenhouse; pot off as soon as strong enough, and preserve in a cool frame or greenhouse, giving plenty of air, and shifting as the plants require it. Plant out in rich soil when all danger of frost is past, and attend to watering in dry weather.

Lunaria biennis (Honesty)—3 feet. Flowers in clusters, purple or white; May and June. Sow in June or July.

Lychnis coronaria—1½ feet. Flowers numerous, single or double, rosy purple; June to September. The double variety, which is that cultivated in gardens, is propagated by division immediately after flowering.

Mathiola incana (Brompton and Queen Stocks).—Of these there are several fine varieties, exhibiting various shades of red, purple, violet, brown, and white, and flowering from April till August or September. The seed should be sown in moderately rich soil about the middle of June, and again a month afterwards. Some of the Ger-

man varieties, however, are late in coming into bloom, and should therefore be sown in May. Transplant as soon as strong enough, in August or early in September, into a dry sheltered border for standing the winter out of doors, with slight protection. At the same time, a quantity should be potted in 5-inch pots, three in each, to be removed on the approach of winter into cold frames, in case of the plants in the open border being injured by frost. These, however, when they do survive, generally produce the finest bloom. In April, or when all danger of severe frost is over, the stocks may be planted out where they are to remain.

Scabiosa atropurpurea—2 feet. Flowers numerous, dark purple; July to September. Sow in September, and plant out in spring.

Silene compacta—1½ feet. Flowers in large clusters, rose; July and August. Sow in the end of September; prick out the seedlings into pots; protect in a cold frame during the winter, and in April shift into large pots for flowering, or plant out in a warm situation. Rich mould mixed with lime rubbish.

Trachelium ceruleum—1½ feet. Flowers small but pretty; July to September. Sow as soon as the seed is ripe; protect from frost, and plant out in spring in a warm situation. Suitable for rockwork.

VIII.—HARDY HERBACEOUS PERENNIALS FOR BEDS AND BORDERS.

	Height in feet.	Colour of Flowers.	Months of Flowering.		Height in feet.	Colour of Flowers.	Months of Flowering.
<i>Adonis vernalis</i> ,	1-1	yellow,	Mar. Apr.	<i>Chelone glabra</i> ,	3	white,	July-Sept.
<i>Alyssum saxatile</i> ,	1-1	yellow,	Apr. May.	<i>Lyoni</i> ,	2	purple,	July-Sept.
<i>Anemone apennina</i> ,	1-1	blue,	Mar. Apr.	<i>Clematis erecta</i> ,	1½	white,	June-Aug.
<i>coronaria</i> , }	1-1	various,	Apr. May.	<i>integrifolia</i> , }	1½	blue,	June-Aug.
<i>hortensis</i> , }	1-1	various,	Apr. May.	<i>Convallaria majalis</i> ,	2	white or red,	Apr.-June
<i>japonica</i> ,	12	purple,	Sept. Oct.	<i>Corydalis nobilis</i> ,	2	pale yellow,	May.
<i>narcissiflora</i> ,	1	white and yellow,	May.	<i>Delphinium</i> , varieties,	1-3	blue,	June-Sept.
<i>pavonia</i> ,	1	crimson,	Apr. May.	<i>Dianthus atrorubens</i> ,	1	red,	June-Sept.
<i>Pulsatilla</i> ,	1-1	violet,	Apr. May.	<i>barbatus</i> ,	1	various,	June-July.
<i>vitifolia</i> ,	2	white,	Sept.	<i>deltoides</i> ,	1	pink,	June-Sept.
<i>Antennaria margaritacea</i> ,	1½	yellow and white,	July-Sept.	<i>Garnierianus</i> ,	1	crimson,	June-Oct.
<i>Anthericum Liliastrum</i> ,	1½	white,	May-July.	<i>superbus</i> ,	1	pale purp. & wh. vs.	July-Sept.
<i>Antirrhinum majus</i> , varieties,	2	various,	June-Aug.	<i>Dictamnus albus</i> ,	2-3	white,	May-July.
<i>Aquilegia canadensis</i> ,	1	orange,	Apr. May.	<i>Fraxinella</i> ,	2-3	purple,	May-July.
<i>formosa</i> ,	1½	red and orange,	May-July.	<i>Dielytra spectabilis</i> ,	2	rose and yellow,	Apr.-July.
<i>glandulosa</i> ,	1½	blue and white,	May-July.	<i>Dodecatheon Meadia</i> ,	1	purple and wh. vs.	Apr.-June
<i>sibirica</i> ,	1	blue and white,	May-July.	<i>Doronicum caucasicum</i> ,	1	yellow,	June-Aug.
<i>Skinneri</i> ,	1½	scarlet and green,	Apr. May.	<i>Dracocephalum argunense</i> ,	1½	blue,	July-Aug.
<i>vulgaris</i> , varieties,	2	various,	May-June.	<i>alpinum</i> ,	1	yellow,	Apr. May.
<i>Arabis albidia</i> ,	1	white,	Jan.-Oct.	<i>Epimedium macranthum</i> ,	1	white,	April.
<i>lucida</i> ,	1	white,	June-July.	<i>violaceum</i> ,	1	violet,	Apr. May.
<i>Asclepias amena</i> ,	3	purple,	July-Aug.	<i>Eremurus spectabilis</i> ,	2	yellow,	May-June.
<i>tuberosa</i> ,	2	orange,	July-Sept.	<i>Eryngium alpinum</i> ,	2	blue,	July-Aug.
<i>Asphodelus luteus</i> ,	3	yellow,	May-June.	<i>Farfugium grande</i> ,	1	blotched foliage,	—
<i>ramosus</i> ,	3	white,	May.	<i>Funkia ovata</i> ,	1½	blue,	June-July.
<i>Aster Amellus</i> ,	2	purpl.	Aug. Sept.	<i>subcordata</i> ,	1	white,	Aug. Sep.
<i>alpinus</i> ,	1	pur. & white vars.,	June-Aug.	<i>Gaura Lindheimeri</i> ,	3	white and red,	July-Oct.
<i>grandiflorus</i> ,	2	blue,	Oct. Nov.	<i>Gentiana acaulis</i> ,	1	blue,	Mar.-May.
<i>Novæ-Angliæ ruber</i> ,	5	red,	Sept. Oct.	<i>aculeata</i> ,	1	blue,	July-Aug.
<i>Aubrietia deltoidea</i> ,	1	purple,	Apr.-June	<i>lutea</i> ,	4	yellow,	July.
<i>purpurea</i> ,	1	purple,	Apr.-June	<i>verna</i> ,	1	blue,	Apr. May.
<i>Baptisia australis</i> ,	2½	blue,	June-July	<i>Geum coccineum</i> ,	1½	scarlet,	June-July.
<i>Bellis perennis</i> ,	1	red, white, & varie- gated varieties,	June-July Mar.-Aug.	<i>Gillenia trifoliata</i> ,	2	rose and white,	July-Aug.
<i>Calystegia pubescens</i> , } climb- <i>sepium incarnata</i> , } ing,	5 6	rose, rose and white,	June-Sept. June-Sept.	<i>Helleborus niger</i> ,	1	pink,	Jan.-Mar.
<i>Campanula carpatia</i> ,	1	blue & white vars.,	June-Aug.	<i>Helonias bullata</i> ,	1	rosy purple,	Apr. May.
<i>glomerata</i> ,	1	blue, lilac, & wh. vs.	May-Sept.	<i>Hemerocallis flava</i> ,	2	yellow,	June.
<i>macrantha</i> ,	3	violet,	June-July.	<i>Hepatica triloba</i> ,	1	bl., red, and wh. vs.	Feb. Mar.
<i>nobilis</i> ,	4	purp. and white vs.	July-Aug.	<i>Hesperis matronalis</i> ,	2	wh. and purpl. vs.	June-Sept.
<i>persicifolia</i> ,	2	white,	July-Sept.	<i>Hieracium aurantiacum</i> ,	1½	orange,	June-Aug.
<i>pyramidalis</i> ,	4	blue and white vs.	July-Sept.	<i>Iberis Tenoreana</i> ,	1	pale purple,	June-July.
<i>Catananche carulea</i> ,	3	blue,	July-Oct.	<i>amœna</i> ,	1	blue,	Apr. May.
<i>bicolor</i> ,	3	blue and white,	July-Oct.	<i>Iris florentina</i> ,	2	white,	May-June.
<i>Centaurea montana</i> ,	1½	blue,	June-Aug.	<i>germanica</i> varieties,	3	various,	May-June.
<i>Cheiranthus Cheiri</i> , wall- <i>flower</i> ,	1½ 1½	{ yellow, purple, & { brown varieties,	Apr.-July. Apr.-June	<i>pumila</i> ,	1	various,	Apr. May.
<i>Marshalli</i> ,	1	yellow,	Apr.-June	<i>sibirica</i> ,	2	blue and white,	May-June.
<i>ochroleucus</i> ,	1	pale yellow,	Apr.-July.	<i>susiana</i> ,	2	dark purpl. and wh.	May-June.
<i>Chelone barbata</i> ,	3	scarlet,	June-Sept.	<i>tuberosa</i> ,	2	purple,	April.
				<i>variegata</i> ,	2	wh. & purp. vargd.	May-Sept.
				<i>Lathyrus latifolius</i> (climbing),	6	purple and wh. vs.	July-Sept.

	Height in feet.	Colour of Flowers.	Months of Flowering.		Height in feet.	Colour of Flowers.	Months of Flowering.
<i>Liatris scariosa</i> ,	3	purple,	Sept. Oct.	<i>Pulmonaria virginica</i> ,	1½	blue,	Mar.-May.
<i>spicata</i> ,	3	purple,	Aug. Sept.	<i>Ranunculus aconitifolius</i> , dbl.	1	white,	May, June.
<i>Linum flavum</i> ,	2½	yellow,	June-Aug.	<i>acris</i> , double,	1	yellow,	June.
<i>Lewisii</i> ,	2-3	blue,	June, July.	<i>Sanguinaria canadensis</i> ,	½	white,	Mar. Apr.
<i>perenne fl. albo</i> ,	2	white,	June, July.	<i>Saxifraga crassifolia</i> ,	1	rose,	Mar.-May.
<i>Lobelia syphilitica</i> ,	2	blue,	Aug.-Oct.	<i>pyramidalis</i> ,	2	white,	May, June.
<i>fulgens</i> ,	3	scarlet,	May-Sept.	<i>Scabiosa caucasica</i> ,	2	pale blue,	July-Sept.
<i>Lupinus polyphyllus</i> ,	4	blue,	June, July.	<i>Silene Schafta</i> ,	2	rosy purple,	July-Sept.
<i>lepidus</i> ,	½	blue and pink,	June-Sept.	<i>Sisyrinchium anceps</i> ,	1	blue,	June July.
<i>Lychnis chalconica</i> ,	2	scarlet and wh. vs.	June, July.	<i>grandiflorum</i> ,	1½	purple,	May, June.
<i>fulgens</i> ,	1½	scarlet,	June July.	<i>Spiraea Filipendula</i> , double,	1½	white,	June-Sept.
<i>viscaria</i> , double,	1	purple,	June July.	<i>venusta</i> ,	3	rose,	July, Aug.
<i>Lysimachia verticillata</i> , . .	1	yellow,	June.	<i>Statice latifolia</i> ,	1	blue,	June, July.
<i>Lythrum roseum superbum</i> , . .	3	rose,	July, Aug.	<i>tatarica</i> ,	1½	pink,	June.
<i>Morina longiflora</i> ,	3	red and white,	July-Nov.	<i>Stenactis speciosa</i> ,	2	purple,	July-Oct.
<i>Myosotis palustris</i> ,	1	blue,	Apr.-Aug.	<i>Stipa pennata</i> ,	2	feather-like beards,	July, Aug.
<i>Oenothera acaulis</i> ,	½	white,	June-Sept.	<i>Thalictrum aquilegifolium</i> , . .	3	white stamens,	May-July.
<i>Fraseri</i> ,	1½	yellow,	May-Sept.	<i>purpurescens</i> ,	3	purple stamens,	May-July.
<i>macrocarpa</i> ,	1	yellow,	July, Aug.	<i>glaucom</i> ,	5	yellow,	June, July.
<i>taraxacifolia</i> ,	1	white,	May-Sept.	<i>Tradescantia virginica</i> ,	1½	blue, red, & wh. vs.	May-Oct.
<i>Omphalodes verna</i> ,	½	blue,	Mar. Apr.	<i>Tritoma Burchelli</i> ,	2-3	red and yellow,	July-Sept.
<i>Onosma tauricum</i> ,	½	yellow,	Apr.-June.	<i>pumila</i> ,	1	orange,	Sept.-Nov.
<i>Orobus vernus</i> ,	1	purple,	Mar. Apr.	<i>Uvaria</i> ,	2-3	orange,	Aug. Sept.
<i>Peonia officinalis</i> , <i>tenni-</i>				<i>Trollius asiaticus</i> ,	1	orange,	May, June.
<i>folia, albiflora, fragrans,</i>				<i>europæus</i> ,	2	yellow,	May, June.
and numerous fine varieties obtained from	1-3	various,	May June.	<i>Tussilago fragrans</i> ,	1	white,	Jan.-Mar.
these and other species,)				<i>Valeriana rubra</i> ,	1-2	red,	July-Sept.
<i>Papaver bracteatum</i> ,	3-4	deep red,	May, June.	<i>Veratrum viride</i> ,	4	green,	July, Aug.
<i>Pentstemon varieties</i> ,	1-2	various,	May-Oct.	<i>Verbascum phoeniceum</i> ,	2-3	purple,	July, Aug.
<i>Phlox varieties</i> ,	1-3	various,	Apr.-Oct.	<i>Veronica gentianoides</i> ,	2	blue,	May, June.
<i>Platycodon grandiflorum</i> , . .	2-3	blue,	June, July.	<i>longifolia</i> ,	3	blue wh. & flesh vs.	July-Sept.
<i>Polemonium cæruleum</i> ,	2	blue and white vs.	June.	<i>paniculata</i> ,	1½	rose,	June, July.
<i>Potentilla varieties</i> ,	1-2	pur., red, and yel.	May-Sept.	<i>Vinca herbacea</i> , (trailing), . .	1½	blue,	June, July.
<i>Primula cortusoides</i> ,	1	purple,	May-July.	<i>Viola altaica</i> ,	½	violet,	Apr. May.
<i>veris</i> ,	½	yellow,	May, June.	<i>odorata</i> ,	½	single and dbl. blue,	
<i>vulgaris</i> ,	½	various,	Mar.-May.			purple & white vs.	Mar.-May.
<i>Pulmonaria sibirica</i> ,	3	blue,	June, July.	<i>Zauschneria californica</i> , . . .	3	scarlet,	July-Oct.

Herbaceous Plants for Rockwork.

<i>Achillea tomentosa</i> .	<i>Corydalis lutea</i> .
<i>Alchemilla alpina</i> .	<i>Crucianella stylosa</i> .
<i>Alyssum saxatile</i> .	<i>Dianthus barbatus</i> .
<i>Anemone apennina</i> .	<i>caesius</i> .
<i>japonica</i> .	<i>deltoides</i> .
<i>Anthyllis montana</i> .	<i>plumarius</i> .
<i>Antirrhinum majus</i> .	<i>superbus</i> .
<i>Aquilegia alpina</i> .	<i>Draba aizoides</i> .
<i>canadensis</i> .	<i>Dryas octopetala</i> .
<i>glandulosa</i> .	<i>Epimedium alpinum</i> .
<i>jucunda</i> .	<i>macranthum</i> .
<i>Arabis albidia</i> .	<i>violaceum</i> .
<i>alpina</i> .	<i>Erinus alpinus</i> .
<i>Arenaria balearica</i> .	<i>hispanicus</i> .
<i>Aretia Vitaliana</i> .	<i>Gentiana acaulis</i> .
<i>Asperula odorata</i> .	<i>verna</i> .
<i>Aster alpinus</i> .	<i>Gypsophila paniculata</i> .
" <i>albus</i> .	<i>prostrata</i> .
<i>Aubrietia deltoidea</i> .	<i>Heuchera americana</i> .
<i>purpurea</i> .	<i>Iberis gibraltaria</i> .
<i>Campanula alpina</i> .	<i>sempervirens</i> .
<i>cæspitosa</i> .	<i>Tenoreana</i> .
<i>carpatia</i> .	<i>Iris lutescens</i> .
<i>fragilis</i> .	<i>pumila</i> .
<i>garganica</i> .	<i>Linnæa borealis</i> .
<i>muralis</i> .	<i>Linum perenne</i> .
<i>pulla</i> .	<i>Lychnis alpina</i> .
<i>pumila</i> .	<i>Lysimachia Nummularia</i> .
<i>rotundifolia</i> .	<i>Mimulus moschatus</i> .
<i>Cerastium tomentosum</i> .	<i>Oenothera macrocarpa</i> .
<i>Cheiranthus Cheiri</i> .	<i>prostrata</i> .
" <i>Marshalli</i> .	<i>taraxacifolia</i> .
<i>Convallaria majalis</i> .	<i>Omphalodes verna</i> .

<i>Onosma tauricum</i> .	<i>Saxifraga sarmentosa</i> .
<i>Phlox divaricata</i> .	<i>Schivereckia podolica</i> .
<i>nivalis</i> .	<i>Sedum Aizoon</i> .
<i>procumbens</i> .	<i>Anacampteros</i> .
<i>reptans</i> .	<i>Forsterianum</i> .
<i>stolonifera</i> .	<i>populifolium</i> .
<i>subulata</i> .	<i>rupestre</i> .
<i>Polemonium reptans</i> .	<i>Sieboldii</i> .
<i>Potentilla insignis</i> .	<i>Sempervivum arachnoideum</i> .
<i>rupestris</i> .	<i>globiferum</i> .
<i>verna</i> .	<i>tectorum</i> .
<i>Rhodiola rosea</i> .	<i>Soldanella alpina</i> .
<i>Rubus saxatilis</i> .	<i>montana</i> .
<i>Saponaria ocyroides</i> .	<i>Stipa pennata</i> .
<i>Saxifraga cæspitosa</i> .	<i>Veronica gentianoides</i> .
<i>crassifolia</i> .	<i>repens</i> .
<i>granulata plena</i> .	<i>saxatilis</i> .
<i>hirsuta</i> .	<i>Vinca herbacea</i> .
<i>oppositifolia</i> .	<i>Viola lutea</i> .
<i>rotundifolia</i> .	<i>odorata</i> .

Aquatic Plants.

<i>Acorus Calamus</i> .	<i>Nymphaea alba</i> .
* <i>Aponogeton distachyon</i> .	<i>odorata</i> .
* <i>Calla æthiopica</i> .	<i>Pontederia cordata</i> .
<i>palustris</i> .	<i>Sagittaria latifolia</i> .
<i>Hottonia palustris</i> .	<i>sagittifolia</i> .
<i>Iris Pseud-acorus</i> .	* <i>Thalia dealbata</i> .
<i>Menyanthes trifoliata</i> .	<i>Typha latifolia</i> .
<i>Nuphar advena</i> .	<i>Villarsia nymphoides</i> .
<i>lutea</i> .	

Plants suitable for planting round the edges of Ponds, &c.

<i>Arundo Donax</i> .	<i>Butomus umbellatus</i> .
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* Greenhouse in winter.

Caltha palustris flore pleno. *Lythrum roseum* superbum.
Heimerocallis fulva. *Myosotis palustris*.
Houttuynia cordata. *Parnassia palustris*.
Iris foetidissima.

General Culture of Herbaceous Perennials.
 —Many of the plants enumerated in the preceding lists will grow in soil that would be too heavy for the generality; but as our limits will not admit of the culture of each being specially noticed, it may be stated that all will grow in soil that is light, rich, and friable. Those that are observed to produce offsets may be propagated most readily by division of the roots; and this operation should be performed before the plants commence to make fresh growth in spring; others are easily raised from seeds, layers, and cuttings. In arranging for planting, tall sorts should be selected for being planted farthest from the edge of the bed; and where it is not desired to have the plants in a bed in flower at one time, early and late flowers may be made to alternate, in order that the gay appearance of the whole may be long-continued. The contrast of colours should also be attended to. On this we may briefly remark, that red or rose-coloured flowers contrast very well with green foliage, deep red with deep blue flowers, blue with

orange, and purple with yellow. But according to Chevreul we should separate red from orange; pink from violet, scarlet, and crimson; orange from orange yellow; and blue from violet. The separation of colours that contrast badly may be effected by the intervention of white flowers.

After planting little attention is required besides watering when necessary, and keeping the ground clean, till such time as certain plants require support. This should be done neatly, so as to prevent the stalks from breaking down, yet leaving them as free as possible, not bundled together like sheaves of corn set on end. After flowering the stalks should be cut back, but only partially if the leaves near their bases are still fresh and vigorous.

In the course of the summer the flowering should be observed, in order to ascertain whether the arrangement of the plants can be improved; and if so, that can be done in autumn or early in spring, when the whole should be regulated by reducing such as have spread out of bounds, and a similar regulation should take place every year. After several seasons' growth the plants will thrive and flower better if they are taken up, the ground half trenched or deeply dug, and planted afresh.

IX.—HARDY BULBS.

	Height in feet.	Colour of Flowers.	Months of Flowering.		Height in feet.	Colour of Flowers.	Months of Flowering.
<i>Allium azureum</i> ,	1	blue,	Sept. Oct.	<i>Iris xiphioides</i> ,	1½	various,	June.
<i>fragrans</i> ,	1½	white,	Sept. Oct.	<i>Xiphioides</i> ,	1½	various,	June.
<i>Amaryllis Belladonna</i> ,	2	red,	July-Sept.	<i>Leucojum æstivum</i> ,	1½	white,	Apr. May.
<i>Anomatheca cruenta</i> ,	1	red,	May-Sept.	<i>vernum</i> ,	¾	white,	Feb. Mar.
<i>Bulbocodium vernum</i> ,	¾	purple,	March.	<i>Lilium</i> , hardy species & vars.	1-4	wh. yel. or. and red.	June-Sept.
<i>Colchicum autumnale</i> ,	¾	purple and wh. vs.	Sept. Oct.	<i>Muscari comosum monstro-</i>	¾	blue,	Apr. May.
<i>variegatum</i> ,	¾	purple,	Aug.-Oct.	<i>moschatum</i> ,	¾	blue and yellow, .	Apr. May.
<i>Crocus</i> , varieties,	¾	various,	Feb. Mar.	<i>Narcissus</i> species and varieties,	¾-1½	white and yellow,	Mar.-May.
<i>sativus</i> ,	¾	violet,	Sept. Oct.	<i>Ornithogalum fimbriatum</i> ,	¾	white,	Feb. Mar.
<i>serotinus</i> ,	¾	violet,	Oct. Nov.	<i>pyramidale</i> ,	2	white,	June, July.
<i>Cyclamen coum</i> ,	¾	red,	Jan.-Apr.	<i>umbellatum</i> ,	1	white,	Apr.-June.
<i>europeum</i> ,	¾	red,	Aug. Sept.	<i>Oxalis Deppei</i> ,	¾	red,	May-Nov.
<i>hederaefolium</i> ,	¾	purp. and white vs.	Apr.-Aug.	<i>Pancratium illyricum</i> ,	1½	white,	May, June.
<i>Eranthis hyemalis</i> ,	¾	yellow,	Jan.-Mar.	<i>maritimum</i> ,	2	white,	May-July.
<i>Erythronium Dens-canis</i> ,	¾	purple and wh. vs.	March.	<i>Scilla amoena</i> ,	¾	blue,	Mar. Apr.
<i>Fritillaria imperialis</i> ,	4	various,	Mar. Apr.	<i>bifolia</i> ,	4	blue, pink & wh. vs.	Feb.-Apr.
<i>meleagris</i> ,	1	various,	Mar. Apr.	<i>campanulata</i> ,	1	blue, wh. & pink vs.	May, June.
<i>persica</i> ,	1½	dull purple,	April.	<i>italica</i> ,	1	blue,	Apr.-June.
<i>præcox</i> ,	1	white,	Mar. Apr.	<i>peruviana</i> ,	1	blue and white vs.	May.
<i>Galanthus nivalis</i> ,	¾	white,	Jan.-Mar.	<i>præcox</i> ,	1	blue,	Mar. Apr.
<i>plicatus</i> ,	¾	white,	Jan.-Mar.	<i>verna</i> ,	¾	blue and white vs.	Apr. May.
<i>Gladiolus byzantinus</i> , } vars.	1-2	various,	June, July.	<i>Sternbergia lutea</i> ,	¾	yellow,	Aug. Sept.
<i>cardinalis</i> , } vars.	1-2	various,	June, July.	<i>Tigridia pavonia</i> ,	1	red, yel. and purple,	Aug. Sept.
<i>Colvilli communis</i> , } vars.	1-2	various,	June, July.	<i>conchiflora</i> ,	1	yellow and purple,	Aug. Sept.
<i>floribundus</i> , } varieties.	1-5	various,	July, Aug.	<i>Zephyranthes Atamasco</i> ,	¾	white,	May, June.
<i>gandavensis</i> , } varieties.	1-5	various,	Aug.-Oct.	<i>candida</i> ,	¾	white,	Sept.
<i>ramosus</i> , } varieties.	1-5	various,	Aug.-Oct.				

Bulbous plants in general require a light, rich, rather sandy soil, or turfy sandy loam, well reduced and made fine by turning; almost all of those enumerated above will, however, succeed in any good well-drained garden soil

which is not of a retentive nature. For the gladiolus and tritonia a mixture of sandy loam and leaf-mould or peat is the most suitable; and a portion of thoroughly decomposed cow-dung may be advantageously incorporated with the

soil, when this is of a poor nature. Crocuses should be replanted every second or third year; but to have them fine they must be taken up every year when their leaves fade, and kept in a dry place till October, when the finest should be selected for planting where the greatest display is intended to be made. The early flowering varieties of gladiolus should be taken up as soon as the leaves have faded, and kept in a dry airy place till October or November, when they may be replanted; in the case of the ramosus varieties this operation should be performed at the latter period, or in January or February; whilst for *gandavensis* and other late kinds it should be executed in April, and in unfavourable seasons it may be deferred till May. If planted 6 inches deep, the bulbs may remain in the ground all the winter, with the protection of litter in very severe frost. *Amaryllis Belladonna* and *Anomatheca cruenta*, being rather tender, should be planted 6 inches deep, and likewise be protected in winter. The other bulbs should be taken up, separated, and replanted every three or four years.

As it is by the action of the leaves that bulbs are formed, it is evident that cutting them off prematurely, or before they naturally decay, must be very prejudicial; and bulbous plants, if left till their foliage decay, would have, in particular situations, a littery appearance. The whole should therefore be removed immediately after flowering, and replaced at the proper season by well nourished bulbs from the reserve garden, where indeed the prematurely removed ones may be recovered if carefully taken up by a transplanter. Or in some cases the bulbs may be grown in pots, plunged in the beds to flower, and when their flowering is over removed to where their leaves can be allowed to remain to complete their functions.

X.—BEDDING PLANTS.

Formerly the beds and borders of flower gardens presented a poor display compared with what they generally do at the present day. Of good annuals there were few, and the bedding-out system was little known or practised, consequently hardy perennials, exhibiting only stems and leaves for a great part of the summer, occupied the principal portion of the flower garden. About the year 1830, in consequence of the many new annuals which the Horticultural Society introduced by their

unfortunate collector, Douglas, chiefly from the west coast of America, a change began to take place. The hardy herbaceous perennials were, to a great extent, dispensed with, and the beds were completely covered with the bloom of the annuals; but their splendour was not of sufficient duration, and filling up the blanks which resulted was felt to be inconvenient, and this led to the propagation of certain plants which, though requiring protection in winter, were adapted for planting out and flowering in the open air in summer. These are termed bedding-out plants, and they chiefly consist as follows:—*Ageratum cœlestinum* and *mexicanum*, blue: *Alstroemerias*, of various colours: *Anagallis Breweri*, *grandiflora cœrulea*, *Monelli*, blue; and *grandiflora rubra*, red: *Antirrhinum*, of various colours: *Bouvardia flava*, yellow; *longiflora*, white; *splendens*, red: shrubby *Calceolarias*: *Cerastium tomentosum* and *Cineraria maritima*, with white leaves: *Cuphea eminens*, red and yellow; *platycentra*, scarlet, blackish purple, and white; *strigillosa*, scarlet and yellow: Dahlias of the dwarf kinds, such as *Captain Ingram*, *Zelinda*, *Crystal Palace Scarlet*, &c.: *Delphinium formosum*, *Hendersonii*, *magnificum*, &c., blue: *Geraniums*, scarlet and horse-shoe, rose, white, variegated, and ivy-leaved: *Heliotropium corymbosum*, *peruvianum*, *Triomphe de Liège*, and *Miss Nightingale*, lavender; *Beauty of the Boudoir*, dark purple; *Voltaireanum*, dark blue, &c.: *Lantanas*: *Lobelia cardinalis* and *fulgens*, scarlet; *Eri-nus speciosa*, blue; and numerous blue and scarlet varieties: *Lophospermum erubescens* and *Cliftoni*, rose; *Hendersonii*, purple; *scandens*, rosy purple: *Maurandya Barclayana*, violet, white, and rose varieties; *Emeryana*, pink; *semperflorens*, rose, &c.: *Mimulus*, red, orange, yellow, and spotted varieties: *Nasturtium*, double scarlet: *Nierembergia calycina*, white; *gracilis*, white and lilac; *intermedia*, crimson; *Oenothera macrocarpa*, yellow; *taraxacifolia*, white: *Pentstemons* of various colours: *Petunias*: *Salvia azurea* and *patens*, blue; *fulgens* and *splendens*, scarlet: *Senecio elegans*, double crimson, purple, and white varieties: *Trachelium album*, white; *cæruleum*, blue: *Tropæolum Brilliant Triomphe de Gand*, &c., various shades of red: *Verbenas*, various.

With the exception of *Antirrhinums*, *Delphiniums*, *Oenothera*, *Cerastium*, and *Pentstemons*, the plants above enumerated are more or less tender, and require protection in winter.

but they should merely be protected and not excited into active vegetation at that season. Being mostly of an herbaceous nature, and propagated by cuttings, they are apt to damp off in moist weather if not sufficiently rooted before winter. The pots should be well drained and the soil porous; but the best drainage is insured by getting the pots well filled with roots before winter. Keeping this in view, the cuttings should be struck in good time, potted off, and so managed as to form a mass of roots through which water may pass without remaining stagnant. The roots would not, however, keep alive and in healthy condition if some slight action of vegetation were not kept up by the leaves. These, therefore, require to be exposed to light and a circulation of air. Without light the healthy green colour of the foliage cannot be maintained, and sap will not be elaborated to form fresh tissue. Nor with light can this be done if the leaves cannot perspire in consequence of being in an atmosphere which is constantly saturated with moisture. A free circulation of air should therefore be allowed at all times when the state of the weather will permit. The aim should be to have the pots well filled with roots before winter; then the plants ought to be kept in a temperature that will just permit of their being kept merely in a growing state, very slowly progressing, but protected from any check by frost.

Cuttings of verbenas should be taken off in the first fortnight in August: the earlier the better. Pans or wide-mouthed pots should be filled with light sandy loam, or friable loam and leaf-mould, with $1\frac{1}{2}$ inch of silver sand at top. Almost any portion of the plant will strike root, but shoots not showing flower at top are to be preferred; cut them across at the third or fourth joint from the top; pare off closely the bottom leaves, and insert the cutting to the depth of an inch. If shoots with flowering tops must be used, these of course will have to be cut off. Place the cutting pots in a frame near the light, but shade from sun till the cuttings have struck root. Keep the sashes close, but give air when the thermometer inside indicates 65° . After a few days the sashes may be taken off if the weather is mild; robust plants will thus be obtained, and their liability to damp off in winter will be greatly diminished. Pot off when rooted into 3-inch pots, and as soon as the plants are well established expose them well to the light, giving plenty of air, and no more water than

is necessary, nor more heat than is consistent with substantial growth, which should be encouraged in order that the pots may be well filled with roots before winter. During the winter frost and damp must be guarded against, and the temperature should not be allowed to fall below 35° . By a little fire heat with air an excess of moisture may at any time be dispelled.

With regard to geraniums, strong short-jointed cuttings of the scarlet kinds strike readily if taken off in July or August, and inserted in a south border. Gentle waterings should be given in dry weather, and when well rooted they may be potted in light loamy soil, placed on a dry hard bottom, in an open situation, and removed in doors on the approach of frost. A more certain plan, however, with the hybrid, variegated, and all the less succulent kinds, is to insert the cuttings in pots placed near the glass in a cold frame, where they should be shaded from bright sun, and gently watered if the soil is likely to become too dry. When well rooted they may be potted off in 3-inch or in store pots, and placed out of doors on a dry hard bottom, and in an open situation, where they may remain till the approach of frost. They should then be removed to any cool glass structure, and placed near the light, or in default of room they may be housed in a shed or any building secure from frost; but of course they cannot be expected to remain so healthy as under glass. During winter attention should be paid to guarding against frost and damp, and to giving all the air possible in mild weather. Cuttings may also be struck in slight bottom-heat in September, and, when a large stock is required, in March, the plants in this case having been placed in heat to make them produce shoots. When rooted, the young plants should be potted off and forwarded in a mild temperature till May. The bloom from plants obtained in this way is neither so early nor so fine as from autumn struck cuttings. Of the other plants enumerated, *Ageratums*, *Anagallis*, *Bouvardias*, *Calceolarias*, *Cupheas*, *Heliotropes*, *Lantanas*, *Lobelias*, *Manrandyas*, *Mimulus*, *Petunias*, and *Salvias* may be reared in the same way as the *Verbena*. *Calceolarias*, *Ageratums*, and *Salvias* are, however, most readily propagated by cuttings of the young shoots taken off in September. *Cineraria maritima* strikes readily in heat in spring; and at the same season cuttings of *Oenothera* may be inserted under a hand-glass. *Ageratums*, *Anagallis*, *Cerastium*,

Cineraria, Enotheras, Pentstemons, Lobelia Erinus speciosa, and the like, Lophospermums, Salvia patens, and Antirrhinums, may be treated like half-hardy annuals. Cinerarias, Pentstemons, Antirrhinums, Enotheras, Lophospermums, Lobelia fulgens, and Tracheliums may likewise be sown in June and July, and protected in frames during the winter.

The plants having been hardened off by exposure to the air for some time previous, may be planted out about the middle or end of May, according to the season and locality, and this operation should not be deferred, if possible, beyond the first week in June. The more tender species should be reserved for planting last. For strong growing plants the soil ought not to be rich, otherwise they will be apt to produce foliage rather than flowers, but a dressing of loam and leaf-mould, or well decomposed hot-bed mould may be given in most cases with advantage. The best time for applying this compost is in winter; if not then given it should be forked in previous to planting. To check over-luxuriance some keep the plants in the pots, plunging the latter below the surface.

After planting a good watering should be given, and afterwards care must be taken not to allow the plants to suffer from excessive drought; and, should the nights prove cold, protection may be afforded by flower-pots inverted over the plants at night. Subsequently attention will have to be paid to training the shoots so as to cover the ground, pegging down, keeping free of weeds, &c.

XI.—THE ROSE.

The varieties of the rose are extremely numerous, not less than 2000 being supposed to be in existence at the present day. These have been obtained by sowing the seed, crossing, and hybridization from a number of species, mostly indigenous to the warmer parts of Europe and Asia; and in consequence of the changes thus effected, many of the varieties can no longer be referred to any particular species. According to their time of flowering and predominant characters they have been divided by florists into two classes—*Summer Roses* and *Autumnal Roses*, and several groups.

CLASS I.—SUMMER ROSES.

Flowering from May to July.

PROVENCE ROSES.—The individuals composing this group owe their origin to *Rosa centifolia*, a native of the Caucasus. The flowers are generally of a globular shape,

and being very odoriferous, are largely grown for making rose-water. The plants are usually of branching habit, and require, with few exceptions, to be rather closely pruned. The miniature Provence, or Pompon Roses, being of very low growth, are frequently planted as edgings to beds, or in small beds by themselves. Amongst the best varieties of this group are:—

Adrienne de Cardoville—Large, rosy crimson; growth vigorous.

Common or Cabbage—Large, rosy pink; vigorous.

Cristata or Crested—Rose; calyx fringed, giving the buds a crested appearance.

Rachel—Large, rose, pale towards the circumference; vigorous.

Reine de Provence—Large, lilac blush; vigorous.

Roi de Pays Bas—Large, deep pink.

Striped Unique—White, striped with lake, but apt to lose its striped character if planted in rich soil.

Dwarf Burgundy—Very small, deep red.

Spong—Small, pale rose.

White Burgundy—Very small, white, with pink centre.

MOSS ROSES.—These are supposed to have been in the first instance a sport of the Provence, and the accidental disposition to produce moss having become, to a certain extent, constitutional, fresh varieties are obtained by seed. This, however, it may be remarked, produces a large proportion of plants destitute of the mossy covering. Moss roses, especially when on their own roots, should have a warm friable soil, and an open situation, well exposed to the sun. Where these conditions cannot be secured, it is advisable to cultivate plants budded on short stems. The vigorous kinds may be grown as standards, or as pillar roses, and require but little pruning; the other varieties ought to be closely pruned.

Alice Leroi—Lilac, shaded with rose; vigorous.

Angélique Quéfier—Rosy lilac; vigorous.

Baronne de Wassenæz—Bright red; vigorous.

Captain Ingram—Dark purple.

Celina—Rosy crimson, shaded with purple.

Common or Old—Pale rose; vigorous.

De Metz—Glossy rose.

Duchesse d'Abrantes—Flesh-coloured; vigorous.

Etna—Bright crimson, tinged with purple.

Frederic Soulie—Large, crimson purple.

Gloire des Mousseux—Very large, blush.

Lancii—Rosy crimson; vigorous.

Panachée Pleine—White, striped with rose.

Princess Alice—Blush, pink centre; vigorous.

Princesse Adelaide—Pale rose; vigorous.

White Bath—White.

DAMASK ROSES.—These take their name from *R. damascena*, a native of Syria, and introduced into this country in the sixteenth century. The flowers being produced in great abundance, are used for the distillation of rose-water; those of many of the varieties, presenting beautiful shades of pink, salmon, blush, and white, are very ornamental. The plants, which are remarkable for the light colour of their foliage, are hardy, and succeed either as dwarfs or standards; and some of them, such as Madame Hardy, form good pillar roses. In pruning, the shoots of the strongest growers may be shortened to six or seven eyes.

Bachelier—Salmon pink.

La Ville de Bruxelles—Large, bright rose; vigorous.

Madame Hardy—Large, white; vigorous.

Madame Soëtmans—Large, cream white.

Semiramis—Pink, fawn centre.

ALBA ROSES.—These have been obtained by seed and hybridizing from *R. alba*, a native of Central Europe. They are remarkable for the beauty and abundance of their flowers.

Félicité Parmentier—Rosy flesh; vigorous.

La Séduisante—Rosy blush; vigorous.

Lucrèce—Very large, rose, pale towards the edges.

Madame Audot—Pale flesh; vigorous.

Madame Legras—Pure white, centre frequently creamy.

Princesse Lamballe—Pure white; dwarf.

Sophie de Marçilly—Blush, rose centre.

FRENCH ROSES.—This group is the progeny of *R. gallica*, a native of France and the south of Europe. The flowers offer diversity and richness of colouring, combined with great fragrance. The plants are hardy, of compact growth, and suited for cultivation either as standards or dwarfs.

Boula de Nanteuil—Very large, crimson purple.

Célestine—Pale rose.

Colonel Coombes—Very large, bright crimson, shaded with purple; vigorous.

Couronne d'Amour—Very large, deep pink, pale towards the margin.

D'Aguessau—Bright crimson.

Duc de Trévise—Bright crimson, shaded with violet.

Gloire de Colmar—Rich crimson.

Grandissima—Purplish crimson.

Julie d'Etanges—Rosy lilac; vigorous.

Kean, syn. *Shakspeare*—Rich purple, crimson centre; vigorous.

Latour d'Auvergne—Rosy crimson.

Napoleon—Very large, bright rose, shaded with purple; vigorous.

Éillet Parfait—White, striped with crimson; dwarf.

Ohl—Dark crimson, scarlet centre; vigorous.

Perle des Panachées—White, striped with rose.

Prince Regent—Deep rose.

Seipio—Deep crimson.

Triomphe de Jaussens—Rosy crimson, shaded with purple.

William Tell—Very large, bright rose, margin blush; vigorous.

HYBRID PROVENCE or HYBRID FRENCH, are hybrids between the French and Provence roses. They are hardy, and require to be pruned tolerably close.

Blanchefleur—Large, white, tinged with flesh.

Comtesse de Ségur—Pale flesh.

Devigne—Fine flesh.

Emmerance—Pale lemon.

La Ville de Londres—Very large, deep rose, pale towards the margin.

La Volupté, syn. *Letitia*—Large, bright rose, exquisite.

HYBRID CHINESE. HYBRID BOURBON, and HYBRID NOISSETTE ROSES.—These have sprung from the Provence and French, crossed with the Chinese, Bourbon, and Noisette roses. They are vigorous and very hardy, succeeding even in unfavourable soils and situations; and being most abundant bloomers they form magnificent objects, either as standards or pillar roses, for which mode of training the more vigorous kinds are exceedingly well adapted. The strong growers require the shoots to be well thinned in autumn, and shortened a little in spring. The others should be pruned more closely.

Beauty of Billiard—Bright scarlet.

Blarü, No. 2—Very large, rosy blush.

Brennus—Very large, bright crimson; vigorous.

H. B. Charles Duval—Deep pink; vigorous.

Chénédolé—Very large, brilliant light crimson; vigorous.

H. B. Coupe d'Hébé—Deep pink; vigorous.

H. B. Frederick the Second—Crimson purple; vigorous.

Fulgens—Bright crimson; vigorous.

General Jacqueminot—Purplish, crimson; vigorous.

H. B. Juno—Very large, pale rose; vigorous.

Lady Stuart—Silvery blush; dwarf.

H. B. Legouvé—Purplish crimson; vigorous.

H. N. Madame Plantier—Pure white; vigorous.

H. N. Madeline, syn. *Double-Margined Hip*—Cream, edged with crimson; vigorous.

H. N. Nathalie Daniel—Pale peach; vigorous.

H. B. Paul Perras—Very large, pale rose; vigorous.

H. B. Paul Ricant—Rosy crimson; vigorous.

H. B. Richelieu—Pale rose.

Vivid (Paul)—Rich crimson; vigorous.

SCOTCH ROSES.—The Scotch roses have originated from *R. spinosissima*, a low and extremely spiny bush, indigenous to Britain. They produce an abundance of small globular flowers early in summer; and succeeding even in the poorest of soils, they may be planted in parts of the garden where other things will not grow. They are also suitable for forming a hedge round the rosary. There are many varieties differing in the colour of the flowers, which are purple, red, blush, yellow, or white.

THE AUSTRIAN BRIER.—The roses of which this small group is composed are descended from *R. lutea*, a species producing yellow flowers, and indigenous to Germany and the south of France. They are very hardy, succeeding best in a rather poor soil, but with the exception of *Harrisonii* will not bloom well in a smoky atmosphere. The flower-buds being chiefly situated towards the extremities of the shoots, the latter should be shortened very little in pruning; the head, however, must be well thinned. The best are:—

Harrisonii—Golden yellow. An abundant bloomer.

Persian Yellow—Flowers large, deep yellow.

THE DOUBLE YELLOW ROSE (*R. sulphurea*), supposed to be a native of Persia, or of the Levant, is remarkable for the beauty of its large, deep yellow flowers, and the rarity with which these expand properly, if produced at all, a circumstance which is doubtless attributable to the difference between our climate and that of its native country. This being the case, the greatest chance of success would probably be secured by training it against a wall, with an east or west aspect, or upon a south wall if the locality is cold. Mr. W. Paul recommends the following mode of cultivation as that most likely to be attended with success. He says:—"I would advise all who desire to cultivate the Double Yellow rose, to plant it on a border with an eastern or western aspect, not training it to a wall, but growing it as a round bush. Let the locality be airy, the soil rather heavy, and tolerably rich. So soon as the buds break, set a watch over the plant to keep it free from the insects which almost invariably infest it, and which may be done by brushing them off into the hand, or syringing with tobacco water. When the flower-buds are forming, have an eye to their growth; if weakly, or seeming likely to become so, water the plant twice or thrice a week with a solution of guano, using about two ounces to a gallon of pond or rain water. As soon as the flowering season is past, remove some of the shoots, if they have been produced in

such number as to crowd each other, when those suffered to remain will become thoroughly matured by fuller exposure to sun and air. By this procedure one grand point is gained—the formation of wood in the most favourable condition for the production of perfect flowers. In March the plant may be pruned, *but very little*: on the weak shoots, five or six eyes should be left; on the strong ones, from six to nine eyes.”—(*Rose Garden*, Div. II. p. 15).

THE SWEET BRIER or EGLANTINE, *R. rubiginosa*, a native of Britain and most other parts of Europe, is so familiar to every one by the fragrance of its leaves, as to require no comment. There are several varieties having more ornamental flowers than the wild plant, but not excelling it in the scent of the foliage. Among the best of these are:—

Celestial—Blush, semi-double; vigorous.

Double Scarlet—Deep rose, double.

Rose Angle—Lilac rose.

BOURSAULT ROSES.—The roses composing this group owe their origin to *R. alpina*, a native of the Alps, and from their shoots being long and flexible, they are well suited for training on walls, fences, and pillars, and for covering arbours. They are very hardy, growing vigorously, and blooming freely even in unfavourable situations. In pruning, the shoots ought to be well thinned, and shortened a little.

Amadis or *Crimson*—Large, and semi-double, deep crimson purple.

Blush Boursault, syn. *De l'Isle*—Very large, double, blush.

Elegans—Semi-double, rosy crimson.

Gracilis—Full, rosy red.

AYRSHIRE ROSES.—These have sprung from *R. arvensis*, a trailing shrub, indigenous to Britain, and as might be supposed are extremely hardy. They grow rapidly, and are well adapted for covering walls, fences, banks, and pillars, as well as for cultivation as weepers.

Bennett's Seedling, syn. *Thoresbyana*—Small, double, white.

Dundee Rambler—Small, double, white.

Ruga—Large, double, pale flesh.

Splendens—Large, and semi-double, white, with red margin.

EVERGREEN ROSES.—The Evergreen roses have originated from *R. sempervirens*, a native of the central parts of Europe, and are characterized by retaining their foliage till late in winter. They are hardy and vigorous, blooming in large clusters, and forming fine pillar and weeping roses; they are also suitable for covering banks. The shoots should be well thinned in pruning, and left nearly at full length.

Félicité Perpetué—Cream white.

Leopoldine d'Orleans—White, shaded with rose.

Myrianthes Rénonculé—Blush, rose towards the margin.

Princesse Marie—Reddish pink.

Rampante—Pure white.

Spectabile—Large, rosy lilac.

MULTIFLORA ROSES.—These have originated from *R. multiflora*, a native of China and Japan. They all require a warm sheltered situation, and many of them will not succeed unless trained against a wall; those which do not require this protection may be grown as climbers.

De la Grifferaie—Large, blush.

Elegans—Blush and white, double; requires a wall.

Graulhié—Pure white.

Grevillei—Bright rose, variously shaded; requires a wall.

Superba—Bright rose.

HYBRID CLIMBING ROSES.—The roses forming this group are hybrids, some of the Musk rose, others of *R. multiflora*. They are extremely vigorous, and bloom in great profusion.

Laure Davoust—Pink, changing to blush and white, double.

Madame d'Arblay, syn. *Wells's White*—Double, white.

The Garland—Fawn and blush, changing to white.

Russelliana—Crimson purple. A good pillar rose; but in cold situations it requires a wall.

BANKSIAN ROSES.—The origin of these is *R. Banksia*, a native of China. They grow vigorously and bloom abundantly, and at an early period of the season; but being rather tender, they should have the protection of a wall with a warm aspect. In pruning, which should be performed after the plants have flowered, it is merely necessary to thin out badly ripened and over-luxuriant shoots, and to take off the points of those left.

Jaune Sérin—Bright yellow, larger than any other.

White or *Alba*—Small, pure white, very fragrant.

Yellow or *Lutea*—Very small, bright yellow.

CLASS II.—AUTUMNAL ROSES,

Or those blooming from May till November.

MACARTNEY ROSES.—The varieties constituting this small group have been obtained from *R. bracteata*, an evergreen species, brought to this country from China by Lord Macartney. They are all rather tender, requiring for their full success the protection of a wall with a warm aspect. The best is—

Maria Leonida—White, with a blush centre.

MICROPHYLLA ROSES.—These have sprung from *R. microphylla*, a native of the Himalayas. They require a warm soil, and the protection of a wall. The best is—

Rubra or *Common*—Deep red.

MUSK ROSES.—The Musk roses owe their origin to *R. moschata*, a species found wild in the north of Africa and in Persia, and they are remarkable for the odour of their flowers, which resembles that of musk. They are suitable for training on pillars, &c., in warm situations, and against walls in cold ones.

Double White—Yellowish white.

Nivea—White, tinged with rose.

Princesse de Nassau—Cream white, very fragrant.

PERPETUAL SCOTCH ROSES.—These are hybrids of the Scotch, blooming during the summer and autumn. The best is—

Stanwell—Rosy blush, large and double, very fragrant.

PERPETUAL MOSS ROSES.—The varieties of this group are Moss roses flowering in summer and autumn, obtained by crossing the Moss rose with perpetuals. They require a rich soil and close pruning.

Empress Eugénie—Bright red, fine form.

General Druot—Purplish crimson.

Madame Edouard Ory—Bright carmine.

Perpetual White—White, well mossed; vigorous.

Salet—Bright rose; vigorous.

Raphael—Flesh-colour, large and full.

DAMASK PERPETUAL ROSES are hybrids of the Damask, blooming in autumn. They are remarkable for the great fragrance of the flowers, and are very hardy, succeeding as standards, but better on their own roots, and as dwarfs budded on the Dog rose. To insure their success, a rich soil and close pruning are necessary.

Bernard—Salmon.

Celina Dubos—White or pale flesh, large, and very double.

Crimson, syn. *Rose du Roi*.—Bright crimson, large, and very double.

Mogador—Purplish crimson, large.

HYBRID PERPETUAL ROSES.—The numerous varieties composing this beautiful group have chiefly originated from the Damask Perpetual, crossed with hybrids of the Bourbou and Chinese roses. Uniting brilliancy of colour and fragrance in the flowers to great hardiness in the plant, they thrive well and bloom abundantly either as standards or dwarfs even in cold localities, and in the neighbourhood of large towns, where the more delicate kinds of rose will not succeed. They require a rich soil and close pruning.

Alexandrine Bachmeteff—Bright red; vigorous.

Auguste Mie—Pink; vigorous.

Bacchus (Paul)—Bright crimson scarlet.

Baronne Hallex—Dark red.

Baronne Prevost—Rose, very large; vigorous.

Caroline de Sansal—Blush, very large; vigorous.

Comte de Nanteuil—Deep rose; vigorous.

Dr. Julliard—Rosy purple; vigorous.

Duchess d'Orleans—Rose, tinged with lilac; vigorous.

Duchess of Sutherland—Pale rose; vigorous.

Evêque de Nismes—Bright purplish red.

Géant des Batailles—Bright crimson scarlet; very double.

General Bedean—Bright red.

General Brea—Light crimson.

General Castellane—Bright crimson; vigorous.

General Jacqueminot (Plate III.)—Brilliant, glowing red; very large and double; vigorous.

Gloire de Vitry—Bright rose.

Jacques Lafitte—Bright rosy carmine; vigorous.

Joan of Arc—White, rosy centre.

Jules Margottin—Bright carmine, very large.

La Reine—Bright rose, tinged with lilac, very large.

Lion des Combats—Purplish crimson; vigorous.

Lord Palmerston—Cherry red, of fine form.

Lord Raglan—Crimson scarlet; vigorous.

Louis Chaix—Bright red, shaded with crimson.

Louise Magnan—White, tinged with flesh colour.

Louise Peyronny—Silvery rose, very large; vigorous.

Madame de Cambacérés—Rosy carmine; vigorous.

Madame Comtesse—Flesh-colour, finely cupped.

Madame Désirée Giraud—White, striped with carmine.

Madame Domage—Bright rose, very large.

Madame Hector Jaquin—Clear rose, shaded with lilac, large.

Madame Knorr—Rose, edged with blnsh.

Madame Laffay—Deep rose; vigorous.

Madame Martel—White, with a blush of rose; vigorous.

Madame Masson—Reddish crimson, changing to crimson; vigorous.

Madame Place—Rosy pink; vigorous.

Madame Vidot—Flesh, shaded with rose; vigorous.

Madame Vigneron—Silvery rose, large and full.

Mathurin Regnier—Pale rose, fine.

Monsieur de Montigny—Rosy carmine, large and full.

Mrs. Rivers—Pale flesh; vigorous.

Ornement des Jardins—Brilliant crimson, very effective.

Paul Dupuy—Bright crimson, shaded.

Pins the Ninth—Bright crimson; vigorous.

Prince Leon—Vivid crimson.

Queen Victoria (Paul's)—Pale flesh, shaded with pink; vigorous.

Ravel—Brilliant crimson, blooms freely.

Souvenir de Levcon Gower—Dark red, changing to purplish crimson, very large; vigorous.

Souvenir de la Reine d'Angleterre—Bright rose.

Triomphe de l'Exposition—Bright reddish crimson.

Triomphe de Paris—Deep purplish crimson, very large; vigorous.

William Griffiths—Pale lilac rose; vigorous.

William Jesse—Lilac crimson, very large.

BOURBON ROSES.—The origin of this beautiful group was a seedling, supposed to be a hybrid between the Chinese and Four Seasons rose, found in the Isle of Bourbon, and from it numerous varieties have resulted. The vigorous kinds form good standards and pillar roses, and require moderate pruning; those of medium and dwarf growth are best cultivated as low standards and dwarfs; these should be closely pruned.

Acidalie—Blush white; vigorous.

Aurore du Guide—Purplish violet, often bright crimson; vigorous.

Charlemagne—Silvery blush.

Comice de Seine et Marne—Bright crimson, often shaded with purple.

Docteur Leprestre—Bright purplish red.

Dupetit Thouars—Bright crimson; vigorous.

Empress Eugénie—Rose, margin purple.

Ferdinand Deppe—Reddish violet.

George Dupont—Brilliant crimson, shaded with purple.

George Cuvier—Rosy crimson.

Henri Lecoq—Rosy carmine.

La Quintinie—Dark crimson purple.

Madame Angelina—Rich cream, centre fawn; dwarf.

Madame Cousin—Rosy flesh.

Madame Helfenwein—Rosy lilac; vigorous.

Marquis Balbiano—Silvery rose.

Menoux—Bright crimson.

Paul Joseph—Dark purplish crimson.

Prince Albert (Paul)—Bright scarlet crimson.

Reveil—Crimson, shaded with purple.

Sir Joseph Paxton—Rosy crimson; vigorous.

Souchet—Brilliant crimson purple.

Souvenir de la Malmaison (Plate III.)—Pale flesh, very large. One of the finest of this group; vigorous.

Souvenir de l'Exposition—Dark crimson.

Vicomte de Cussy—Bright red.

Vorace—Deep crimson.

NOISETTE ROSES.—These owe their origin to a hybrid between the Musk and the China rose, sent from America to M. Noisette, of Paris, by his brother. They produce large clusters of flowers throughout the season till late in autumn; and with the exception of the kinds hybridized with the Tea-scented, which require a wall, are very hardy, succeeding with ordinary cultivation either as standards or dwarfs; the strongest growers may also be grown as weeping or climbing roses.

Aimée Vibert—Pure white.

Caroline Marniesse—Cream white; vigorous.

Cloth of Gold—Yellow, margin pale; vigorous. Requires a wall with a warm aspect.

Du Luxembourg—Rosy lilac, red centre; vigorous.

La Biche—Pale flesh, very large. A fine pillar rose in a warm situation.

Lamarque—Lemon, very large; vigorous. Requires a sheltered situation.

Madame Massot—Pure white, centre flesh colour; very pretty.



Rosa *centifolia* L. *var. alba* *Grandes* *General* *International* *Exhibition* *1873*

Marie Chargé—Yellow, tinged with carmine.

Miss Glegg—Pure white; dwarf.

Solfaterre—Bright sulphur; vigorous. Requires a wall or sheltered situation.

CHINESE ROSES.—The roses of this group have sprung from the Common China (*R. indica*), and the Crimson China (*R. semperflorens*), both natives of China, and introduced into this country in 1789. They are for the most part dwarf habit, and being tolerably hardy, may, in the warmer parts of the kingdom, be planted in the open ground; but in cold localities the shelter of a wall is requisite, and in either case protection should be afforded in winter by spreading a layer of tan, litter, &c., over the roots, and by sticking evergreens, furze, or fern among the branches; in times of great severity, however, straw-mats may be employed to secure plants against walls. A section of this group, the Lawrenceana or Fairy roses, are remarkable for their diminutive size. They are suitable for pot culture and for planting as edgings, or in small beds in warm dry soils.

Archduke Charles—Pale rose, changing to crimson, very large; vigorous.

Cramoisi Supérieure—Rich crimson.

Desfontaines—White; dwarf.

Eugène Beauharnais—Amaranth.

Fabvier—Bright scarlet.

Henry the Fifth—Crimson striped with white; dwarf.

Murjolin du Luxembourg—Dark crimson, very large; vigorous.

Madame Bréon—Very large, rose.

Madame Bureau—Pure white.

Mrs. Bosanquet—Pale flesh; vigorous.

TEA-SCENTED ROSES.—These roses, alike remarkable for the beauty and fragrance of their flowers, have sprung from the Blush Tea-scented and Yellow Tea-scented varieties of *R. indica*. They are too tender for planting in the open ground, except in the warmest parts of the kingdom, but succeed well against a wall with a warm aspect, if protected in winter like the China roses; and for cultivation under glass, whether in pots, or in conservatory borders, they are better suited than any other group. They may be grown either as dwarfs or standards. In the latter form, however, if planted out of doors, they are more exposed, and therefore require to be very carefully protected from frost. In the conservatory, the vigorous growing kinds form beautiful pillar roses. Tea roses should be planted in rich soil mixed with leaf-mould, and require to be closely pruned.

Adam—Very large, rosy salmon; vigorous.

Bougère—Very large, deep rosy fawn; vigorous.

Clara Sylvain—Pure white.

Comte de Paris—Very large, rosy flesh; vigorous.

Devoniensis—Pale yellow, very large.

Elise Sauvage—Pale yellow, centre buff or orange; dwarf.

Eugène Desgaches—Pale rose; vigorous.

Gloire de Dijon—Very large, yellow, shaded with salmon or rose; vigorous.

Goubault—Very large, bright rose; hardy and vigorous.

Josephine Malton—Cream, buff centre; vigorous.

Julie Mansais—White.

Louise de Savoy—Pale yellow.

Madame de St. Joseph—Very large, pale pink; vigorous.

Madame Lartay—Yellow, shaded with salmon.

Madame Villermoz—White, centre salmon, very large.

Madame William—Rich yellow, large and full.

Moiret—Very large, fawn, shaded with rose; vigorous.

Narcisse—Fine pale yellow.

Niphetos—White, pale lemon centre, very large; vigorous.

Prince Esterhazy—Very large, pale rose.

Princesse Adelaide—Yellow.

Princesse Marie—Rosy pink; vigorous.

Safrano—Pale buff, beautiful in bud; vigorous.

Souvenir d'un Ami—Salmon; vigorous.

Triomphe du Luxembourg—Very large, rosy flesh; vigorous.

Vicomtesse de Cazes—Bright yellow, centre tinged with copper colour.

Propagation.—The rose is propagated by seeds, cuttings, layers, and suckers, and by budding and grafting.

Sowing the seed is exclusively practised with the view of obtaining improved varieties; but few such have been raised in this country, where many of the finest roses only ripen their seed in warm seasons, and many do not seed at all. There are, however, several good sorts which seed freely in ordinary seasons, and among these may be enumerated Chénédolé, Marechal Soult, General Allard, Géant des Batailles, Great Western, Charles Duval, Celine, Madame Laffay, William Jesse, and Duchess of Sutherland. The plants intended for bearing seed ought to be planted in soil which is rather poor than otherwise, and in a warm sheltered situation. The flower-buds when defective or badly exposed to the light should be removed in order to strengthen the rest; and if too many remain after this has been done they must be thinned. When the flowers expand, if hybridization is to be effected, the stamens of the female parent ought to be removed with fine scissors, and as soon as the pollen is ripe it should be applied to the stigma with a camel hair pencil. The seed-pods or hips must remain on the tree till ripe; they may then be placed in pots of earth or sand, and buried in the ground till spring. In the end of February or beginning of March the seeds should be rubbed out of the pods, sown in pans filled with loam and leaf-mould, and covered to the depth of $\frac{1}{2}$ inch with the same kind of soil mixed with some silver sand. The pans should then be placed in a cold frame, and care must be taken to prevent the soil from becoming at any time too dry. Seeds may also be sown in a warm situation in the open ground. The seedlings will appear in the course of the spring, summer, and autumn, and many of them not until the following year; they should be thinned if they come up too thickly, by transplanting a portion as soon

as they can be handled, taking care to water and shade till again established. In autumn, before the approach of frost, the seedlings should be carefully taken up, their tap-roots shortened, and then planted from 6 inches to 1 foot apart, according to size. If frost occur after planting, they must be protected with hoops and mats, furze, or other means; and the same precautions should be taken in the case of seedlings which come up late in autumn or early in spring. The young plants sometimes flower in a month or two after coming up, but it is not advisable to allow them to expand their blossoms so early, as the plant is thereby greatly weakened, and no decisive opinion can be formed as to the merits of the flowers thus prematurely produced. Many will flower in the second season, others not till the third or fourth year. When the plants come into bloom, all those with single flowers should be discarded; the most promising of the others should be preserved till a correct opinion as to their merits can be arrived at.

Cuttings may be struck at any time during the spring, summer, and autumn; those of the Boursault, Hybrid Chinese, Hybrid Bourbon, Hybrid Perpetual, and Ayrshire roses may be struck in a shady border. The cuttings should be about 9 inches in length, and are best taken off with a heel. They may be inserted into the ground to the depth of about 6 inches, and 3 inches apart, in rows 1 foot asunder. In the following autumn they will be fit for planting out. Although the above classes of roses may be thus struck from cuttings, there are others, such as the Bourbon, China, and Tea-scented, which require more careful treatment. In autumn, before the fall of the leaf, the cuttings ought to be taken off about 3 or 4 inches long, and with a heel. When prepared they should be inserted 1 inch deep round the edges of 4-inch pots filled with a mixture of turfy loam, leaf-mould, and silver sand. A gentle watering having been given, the cutting pots should be placed in a frame, and the sashes shut up; but air should be occasionally given to dispel damp. The cuttings will be rooted in the following spring. Cuttings may also be easily struck if taken off in summer, immediately after the plants have flowered, prepared, and potted as above, set in a cold frame for a few days, and then placed in bottom heat. When rooted they should be potted off, replaced in heat till again established, then removed to a cold

frame, and hardened off. Lastly, where roses are forced cuttings may be struck in a few weeks, if placed in a bottom heat of about 75°, in spring. Where bottom heat is employed, the cuttings may consist of only a single joint of well-ripened young wood.

Layering is not much practised; it is, however, a sure and easy mode of propagation. The method of layering which is chiefly employed is that represented in fig. 164. It is best performed in June or July, in which case the layers will generally be fit to be separated from the parent plant in the autumn of the same year; but if the process of layering is not commenced till a later period of the season, they will not, in general, be fit for removal till the following year. It is necessary to observe, that the ground in which the branch is laid should be made fine.

Suckers are often produced, and these if taken off in autumn, either with or without roots, will generally grow.

Budding is the mode by which the varieties are chiefly perpetuated. The stocks usually employed are the Dog Rose, Celina, Boursault, and the Manettii.

The Dog rose is in general the best stock. It is obtained from the hedges, whence it may be removed in autumn or early in spring. Well-ripened suckers, and plants two or three years old, free from side branches, are to be preferred; and their roots having been trimmed, the tops shortened to from 6 inches to 4 feet, according to the height at which they are to be budded, and side branches removed, they may be planted in nursery rows. When the buds begin to push in spring the whole of them should be rubbed off, with the exception of two or three situated nearest the top—if three, the preferable number, they should form a triangle.

The Celina makes a good stock for Bourbons and Noisettes, and may be readily propagated by cuttings. The Blush and Crimson Boursault, from emitting a large quantity of roots, answer well for China and Tea-scented roses to be grown in pots; but as they are apt to die off are not to be recommended for plants not so confined. The Manettii rose has been greatly lauded as a stock, but according to Mr. Paul, "its nature is too gross for any but the free-growing kinds, and for them it possesses no advantage over the Dog rose. Many kinds budded on it grow more rapidly the first year, but decline and die afterwards, owing

we believe, to an over-excited growth. For pot culture we are disposed to use it; because in this condition its exuberance is somewhat checked, and pot-roses usually receive a closer watching for the destruction of wild shoots than such as are planted in the open ground. The freedom with which this stock throws up young shoots, which, if not closely watched, impoverish and destroy the budded variety, is a second great objection to its general use."—(*Supplement to the Rose Garden.*)

For pot-culture, however, and for delicate growers in poor light soils this stock succeeds very well. Both Boursault and Manettii stocks are propagated by cuttings; the former may likewise be obtained by layering by circumposition in July, as recommended by Mr. Rivers, tonguing the shoot, and using a mixture of rotten dung, loam, and sand. The shoot may be budded at the time of layering, or as soon afterwards as possible, and then headed down to within two eyes of the bud.

The mode in which the operation of budding is effected has been already detailed in the chapter on propagation. In the case of the rose it is performed in July, or as soon as the bark rises freely from the wood. About a month after budding the tying may be loosened, and if the bud has taken, wholly removed; but if this is not the case it must be tied up again. Early in the following spring, before vegetation becomes active, the wild shoot ought to be cut off at two joints above the bud; and when the shoot resulting from the latter has pushed 3 or 4 inches, it should be stopped to encourage the development of buds for the formation of the head. In May, the stock may be cut over immediately above the bud.

Although budding is the mode usually employed for the continuation of the varieties, yet grafting may be successfully, and in some cases, advantageously practised; for instance, when the budding season has from any cause been allowed to pass over without that operation having been performed. There is, however, one drawback in grafting, namely, that the scion and stock rarely effect so complete a junction as in budding. Standard roses may be worked at the usual season for grafting fruit trees, in March; but for roses in pots Mr. Paul recommends January, the stocks having been placed in bottom-heat for a week or ten days previous to the operation, and afterwards they must be kept there till the

graft has taken. The scions should be 2 or 3 inches in length, and should be taken from well-ripened shoots. They may be applied to the stocks in any of the modes already described. All suckers that may spring from the stock should be stopped as soon as they appear, and when the union between the scion and stock is complete, plants in pots which have been kept in heat may be gradually hardened off. The shoot resulting from the graft should be treated like that produced by budding.

Soil and Situation.—The rose succeeds best in a rich, deep, loamy soil, of a rather stiff nature, but free from stagnant moisture. Roses on their own roots will, however, succeed in lighter soils than they would do when budded on the Dog rose, which naturally grows in stiff land. Heavy clays and light sandy or gravelly soils, as well as those which are badly drained, are unfavourable to the health and longevity of the plant, and in such it will not flourish for any length of time unless artificial means are resorted to for their improvement; but these having been already pointed out in a previous chapter, need not be further alluded to here. Of course, where the ground is not capable of being sufficiently improved the natural soil will have to be dug out and replaced, either partially or wholly, with soil of the proper description. In connection with this subject it will be necessary to advert to the most suitable manures; for the soil in which roses are to be planted may be naturally poor, and therefore in need of artificial enrichment; or it may have become impoverished from long cropping. The kind of manure must to some extent be regulated by the nature of the soil; thus, in light soils the application of substances which would tend to render them still lighter, would, it is obvious, be injurious; whilst in ground of a heavy nature manures of a contrary tendency will prove beneficial. To light soils a dressing of strong loam will be very advantageous, especially if applied in conjunction with cow-dung, or night-soil. The latter, indeed, is perhaps the best manure that can be used in all but very rich soils, provided it is not employed in a fresh state, and in too great quantity. It is best applied when mixed with a quantity of loam, and laid in a heap for a year or more, and turned occasionally. To heavy soils chalk, peat, burned earth, or sand should be applied, and such manures as stable dung, leaf-mould, and burned earth saturated

with liquid manure. Except in the richest soils, plantations of roses ought to be manured every year.

With regard to situation, an open spot with an east or southern exposure, and sheltered from strong winds, but not shaded by tall trees or lofty buildings, is the best. Roses produce the best effect when planted by themselves, for the straight naked stems of the varieties grown as standards contrast unfavourably with shrubs, and indeed all other vegetation which is not of a dwarf character. Where, therefore, plenty of space can be afforded, a rosary should be formed. The form and arrangement of this must, to a considerable extent, be dependent on taste, the form of the ground, and other circumstances. A regular figure is, however, to be preferred, and it should be separated into two divisions, one for summer, the other for autumnal roses. The laying out of the ground is of course a matter of taste; but the beds, whatever their figure may be, ought not to exceed 6 feet in width, in order that the flowers may be inspected without treading on the ground. The walks may either be of grass or gravel; the former are cooler, softer, and when kept nicely mown present a better appearance than those of gravel; moreover, the green sward is refreshing to the eyes after these have been gazing upon the brilliant hues of the flowers; in fact, the predominant colour in a rosary is red, and of this green is the complementary. The only objection to grass walks is, that they are unpleasant to walk upon early in the morning, late in the evening, and after wet weather; and in this respect gravel has the advantage. In many cases ground cannot be spared for the formation of a proper rosary, and the plants must consequently be introduced into the flower garden or pleasure ground; a few remarks on the most proper situations for planting in these will therefore be necessary. Standard roses may be planted in clumps or beds on lawns, or along the sides of walks when the borders are filled with plants of low growth. The lawn is likewise a suitable position for dwarfs in beds, also for pillar and weeping roses, than which, when planted either singly or in groups, few objects can be more ornamental on a lawn. Climbing roses may be employed wherever it is desired to hide unsightly objects, for forming arbours, covering arches, or making festoons along the sides of walks. The Evergreen and Ayrshire roses

may also be planted for covering the surface of the ground, or introduced into shrubberies, for which purpose the Scotch roses are also suitable.

Planting.—The most proper time for this, in the case of the hybrid perpetuals and other hardy kinds, is in October or November; but if the ground is not in good order, or is of a very strong nature, planting had better be deferred till early in spring. The China and other tender varieties are very liable to be injured by frost if planted in autumn; this operation, therefore, should in their case be deferred till March or April, or, if the plants are very young, till all danger of frost is over.

With the view of obtaining flowers late in autumn, hybrid perpetuals are sometimes taken up in February; and, after the roots have been shortened, planted in a cool border, where they remain till the end of April. They are then again taken up, and their tops having been closely pruned, planted in well-manured loamy soil. The same treatment must be pursued every year when it is desired to have roses thus late in the season. It may also be remarked that the greater portion of the buds produced in summer should be pinched off at an early stage of their growth, otherwise the plants are likely to afford only a poor show of bloom in winter.

Standard roses should be allowed a distance of 3 feet from plant to plant; dwarfs from 1 foot to 3 feet, according as the variety is less or more vigorous. They may also be planted in the intervals between standards. The ground, if the roses are to be planted in beds, ought to be trenched 3 feet deep, and the soil which is thrown out of the holes mixed with some well decomposed manure. The addition of leaf-mould will likewise prove beneficial, especially in heavy soils. In such, according to Mr. Paul, this substance is almost indispensable for the success of the Tea-scented varieties. Where roses are to be planted on lawns, the turf should be removed from a circle about 6 feet in diameter, and the soil thrown out to the depth of 3 feet. It should then be mixed with more or less of the subsoil if this be a good loam; but when both soil and subsoil are bad, they ought to be replaced with good fresh loam mixed with some old manure. In planting, the soil ought to be filled in and trodden to prevent sinking, the roots should then be spread out horizontally within 5 or 6 inches of the surface, and covered with soil, which must afterwards be trodden firm. Standards should then be secured to stakes, and if

planted on a lawn the turf may be replaced so as to leave uncovered a circle 2 or 3 feet in diameter. After planting, the ground should be mulched with litter, and if necessary water must be given from time to time.

Pruning.—The mode and amount of pruning depends on the class to which the rose belongs, the method of training which is adopted, the natural vigour of the variety, and the health and strength of the individual operated on. The operation is best performed in November or in March; and each season is attended with its advantages and its disadvantages. By removing a portion of the shoots in autumn the sap flows in greater abundance in those which are left, and the result is that the buds push vigorously and regularly; the flowers are also earlier and more abundant than when pruning is performed in spring. "But autumn pruning," says Mr. Paul, "has its disadvantages, the greatest of which is this:—A few mild days in winter often excite the buds of autumn-pruned roses, and they push forth; severe weather follows; the young shoots are frosted, and the bloom injured. This is more particularly the case with the Chinese Noisette, Bourbon, Tea-scented, and the hybrids of these kinds, which we shall term *excitable*, because they are quickly excited to growth. The Provence, Moss, French, Alba, and others, rarely suffer from this cause, as they are not so readily affected by the state of the weather. Be it remarked, however, that the quickness with which buds are roused into action depends much upon how far the shoots were matured the previous autumn; the less mature the more excitable. It will be perceived that there is a difficulty in the way of autumn pruning when applied to the excitable kinds which can only be remedied by affording them protection from frost, should a mild December or January be succeeded by severe weather. But this would entail great additional trouble, and cannot always be done. Let us now turn to the other season.

"The chief advantage gained by deferring pruning till spring is, that the flower shoots are placed beyond the reach of injury by frost. If, during winter, any buds push forth in unpruned roses, it is those at the ends of the branches, and they will be removed by pruning. But there is an evil attendant on this apparent advantage. When pruning is put off till spring, the buds placed at the extremities of the shoots are often found in leaf, and

in the operation we cut off some inches from a shoot in this state. The tree is denuded of its leaves, and thereby receives a check; the sap being in active motion, exudes from the fresh wounds. The lower buds find themselves suddenly in contact with a great supply of food, by the cutting away of the buds beyond them. There is a pause. Soon one or two buds at the extremity of the pruned shoots take up the work; they swell and are developed apace, but all below remain dormant. Thus, spring-pruning is unfavourable to an abundant and regular development of branches and flowers, and, consequently, to the well forming of a tree. The flowers are also usually produced later in the season, and of less size. Thus it may be said that each season has its advantages and disadvantages; but is it impossible to draw from both? We think not; and would strongly recommend that all but the excitable kinds be pruned in autumn; thin out these at the same time, but leave the shortening of their shoots till spring."—(*Rose Garden*, p. 58.)

The extent to which the removal of shoots and portions of shoots ought to be carried depends on the vigour of the plant. If a strong grower more shoots will have to be thinned out than when the contrary is the case; but those left should be pruned long, otherwise wood, and not flowers, will be produced. Weakly growing varieties, on the other hand, require their shoots to be shortened back more closely. The Provence, Moss, Damask, and Alba roses, with the exception of the vigorous kinds, require to be close pruned, or to have their shoots shortened to three or four eyes. The French ought to be well thinned, and shortened to four, five, or six eyes, and the strongest growers should be left still longer. The Boursault, Austrian Brier, Evergreen, and Banksian roses must also be well thinned, but merely the points of the shoots ought to be taken off; the Banksian should be pruned in summer. The Bourbon, Noisette, Chinese, Tea-scented, and their hybrids may be thinned in autumn, but the shortening back of the shoots is better deferred till March. The strongest growers, especially among the hybrids, should be well thinned out, and pruned to from eight to twelve eyes; those of a vigorous growth, but less so than the preceding, to six or seven eyes, and those which are of weakly, or only moderate growth, to three, four, or five eyes.

In thinning out the shoots of any kind of rose, all which are diseased, badly ripened, or which tend to create confusion, or to spoil the form of the tree should be taken off first; and if, after their removal, there are still too many to admit of a free circulation of air and light, or for the tree to support in a healthy condition, a further reduction must be made. In pruning no snags should be left; the shoots ought to be cut off close to their base; and in shortening them the cut must be made in a slanting direction immediately above a bud. In pruning pillar, climbing, and weeping roses, the shoots must be shortened closely at first, to induce the production of a few vigorous shoots; afterwards, the shoots arising from these will have to be left at greater or less length according as there is space to lay them in without confusion, and according to the vigour of the plant and the number of shoots into which it is divided. The short lateral shoots of pillar and climbing roses may be shortened in to from four to seven eyes; but when it is desired to obtain vigorous shoots to fill up a vacancy, they may be pruned to one or two eyes.

To obviate the necessity of removing a large number of shoots by thinning, and consequently wasting the sap of the plants, which is then devoted to the production and nourishment of superabundant shoots, Mr. Paul has suggested the adoption of the practice of disbudding, by means of which their development may be entirely prevented in the first instance. He says: "By rubbing out a portion of the buds when swelling, and others at any season when they may sprout forth in a position where shoots are not wanted, the remaining buds form stronger shoots; and thus perhaps a larger, certainly a healthier surface of foliage is the result. It is bad policy, then, to suffer more buds to be developed as shoots than are required for forming the tree, or for flowering; for by cutting away these when pruning there must be a waste of the elaborated juices of the tree. But this is not the only evil. Beyond this, the tree is sorely maimed in the operation. Now, if the nutritive matter, which has been supplied in the development and sustenance of numerous branches was confined to a lesser number, they would have been more powerfully developed, and the loss by removal, and the injury the tree suffers by thinning would have been avoided. I believe disbudding to be the system best calculated to produce flowers in the finest possible condition,

to keep a plant in full health and vigour, and to bring it to the highest pitch of beauty."

The correctness of the above views has been fully established by long experience, and there can be little doubt that disbudding may be advantageously substituted for thinning; in large collections, however, the practice would involve too great an expenditure of labour, for the trees have to be gone over two or three times before flowering, and once or twice afterwards. In disbudding, as in thinning, the vigour of the plant must be taken into account. If too many buds are removed from the shoots of a strong growing variety, those which are left will be developed into excessively vigorous shoots, with a tendency to produce wood rather than flowers; if, on the other hand, the buds in such sorts are left too close together, the resulting shoots will soon become overcrowded, and the knife will have to be resorted to. Again, in less vigorous kinds a greater number of buds should be rubbed out, but those allowed to remain may stand closer together. When disbudding is not practised the shoots will have to be thinned out after flowering in summer; those of the autumnal roses should be pruned at the same time. The bad effects of depriving a plant of many shoots, or of much foliage, at any one time, were pointed out in the article on pruning; and in managing the rose the remarks on the subject should be borne in mind.

Other Culture.—Every spring the ground should be dug or forked over, and enriched with some well decomposed manure. Suckers must be removed whenever they appear, over-luxuriant shoots should be checked by pinching, or wholly removed if likely to destroy the symmetry of the tree; flower buds ought to be thinned if large and fine flowers are desired rather than quantity; and, lastly, all decayed blooms should be removed. The China and Tea-scented require to be protected in winter; for this purpose branches of fern, fir, or other evergreens may be employed, sticking them thickly into the ground among dwarfs, or tying them on the stem so as to protect the head of standards. A mulching of litter, short dung, peat, or fibrous turf should likewise be placed over the roots.

Culture in Pots.—Roses are always desirable for the decoration of the conservatory during the winter and spring months, and unquestionably the most convenient mode of cultivating them for that purpose is in pots;

moreover, most of the Tea-scented, and indeed many varieties belonging to hardier groups, will only produce their flowers in perfection under glass. Plants for cultivation in pots may be on their own roots, in which way the Chinese and Tea-scented succeed best; or, they may be worked on stems from 6 inches to 1 foot high. If plants growing out of doors are selected, they should be taken up in September or October, when the shoots are ripe, and, the roots having been pruned and the heads thinned, potted firmly in 6, 8, or 9-inch pots, according to their size. The soil may consist of mellow turfy loam, mixed with as much leaf-mould and well decomposed dung in equal parts, and some silver sand if the loam is strong; indeed, the addition of this substance is an improvement in any case. After potting, a gentle watering having been given, the plants should be shut up closely in a frame for a fortnight to make them take fresh root, when they may be gradually hardened off and plunged, in an open situation, up to the rims of the pots, in earth, coal ashes, or old tan, care being taken to place the bottom of the pots on slate, tile, or some other hard substance, in order to prevent the roots from striking into the ground, and worms from getting into the pots. Here the hardy kinds may remain all winter with only a layer of dung over the roots; but those which are delicate ought to be removed, before severe weather sets in, to a cold frame or any structure that will merely protect them from frost; and in spring they may be again plunged out of doors, where they may remain till October, when they may be introduced into a heat of 50° to 55° for flowering. If young plants lately struck from cuttings are preferred to roses taken up from the ground, they should be shifted in spring into 5 or 6-inch pots, according to their vigour, care being taken not to overpot the China and Tea-scented varieties, for these ought not to be shifted until the roots reach the sides of the pots. Afterwards they should be plunged out of doors as already recommended; and during the growing season attention must be paid to disbudding, stopping shoots which are becoming too strong, and encouraging others which from their position are liable to become weak, as well as to pinching off the flower-buds as soon as they appear, for if many of these were allowed to develop themselves the plants would not form such handsome specimens, nor bloom

so well in the following year as would otherwise be the case. In July or August most of the plants will require to be shifted into 8 or 9-inch pots, and if removed in October to a pit or greenhouse the autumnals will bloom throughout the winter; but it is better not to allow them to do so till the second year. During the winter, if not intended to flower the same year, the hardy varieties may be plunged out of doors; but the China, Tea-scented, and Bourbons should have the protection of a frame, air being freely admitted at all times except in frosty weather. In spring the plants should be turned out of their pots, and the greater portion of the old soil having been removed, again potted in fresh soil, using, if necessary, pots a size larger; they may then be plunged out of doors. In October those intended for winter flowering ought to be placed in a pit or greenhouse with a temperature of from 50° to 55°; and, after blooming, they should be removed to a cold pit, shifted in March into 11, 12, or 13-inch pots, according to their vigour, and again plunged out of doors; a second bloom will be produced late in summer.

Plants not intended for flowering in winter ought to be repotted in the end of September, using larger pots when requisite, and plunged in the ground till the time of flowering, when they may be placed in the greenhouse or conservatory.

The time of pruning must be regulated by the season at which the plants are required to be in flower; for the earlier this operation is performed the earlier will the flowers be produced.

By pruning at various periods, and by forcing, roses may be made to flower throughout the year. By pruning in August and September flowers will be obtained from November to February; by forcing, from that period till May; by pruning in November, and merely protecting in a pit, flowers will be produced in April and May; and from that time to October the plants bloom in the open air.

In pruning, the shoots, if at all crowded, should be well thinned by cutting out the weakest and those which tend to cross each other, so that those left may stand at a sufficient distance apart; and this should also be attended to in summer. If, however, disbudding is carefully practised, it will seldom be necessary to remove many of the shoots. Pot-roses require, in general, to be more closely pruned than those growing in the open ground;

and again the shoots ought to be shortened in more in the early stages of their growth than subsequently. The hybrid perpetuals and other autumnals may be cut into two, three, or four eyes, according to their vigour; most of the summer roses, with the exception of the Hybrid Chinese, and other strong growing varieties, which should be left longer, require to be shortened to the same extent. After pruning it is a good plan to bend down to a nearly horizontal position such shoots as are left long, in order to make the buds break regularly from the bottom to the top; but when this takes place the shoots may be restored to their former position.

The general culture of pot-roses consists in stopping over luxuriant shoots, disbudding, tying out the shoots at an early stage of their growth, nipping off the flower-buds where these are not required, shifting into larger pots or into fresh soil, watering, syringing occasionally during the growing season, and keeping free from green fly by fumigation, and the rose-grub by hand-picking. An occasional application of manure-water will prove very beneficial to the plants, but it should not be used too strong, or too frequently, otherwise the shoots will be apt to become over-luxuriant, and the wood will be imperfectly ripened in autumn. Attention should also be paid to protecting the roots of plants plunged out of doors during the winter, by spreading a layer of littery dung over the surface of the soil in the pots before severe frost sets in.

Forcing.—In order to have roses from February to May the plants must be subjected to artificial heat, in a house or pit, where a temperature of 75° can be commanded. Previous to forcing, the plants should be grown for some while in pots, and receive the treatment pursued in the early stages of that mode of cultivation; for if placed in heat immediately after removal from the ground, they seldom develop their flowers in perfection. The length of time which must be passed in this preparatory process depends on whether the plants are worked, or grown on their own roots; in the former case they may be taken up and potted in September, and if introduced into heat the same year, will bloom well; in the latter, a year's growth in pots should be allowed after removal from the ground. Young plants struck from cuttings, and established in pots for two, three, or four years, are, however, more convenient to force than

those of larger size taken from the open ground. The plants having undergone the requisite preparatory culture, may be introduced into heat in the beginning of December, and plunged for a fortnight in a gentle bottom-heat to start them, maintaining an atmospheric temperature of about 50° in the day, and at least 40° by night, and giving abundance of air whenever the weather is favourable. At the expiration of the above period, the plants may be removed from bottom heat, but if they can be continued in it so much the better. The temperature of the house should be gradually raised to 70° or 75° by day, and 50° at night; air should be given when the external temperature is high, in order to dispel damp, care being taken, however, not to admit it in draughts; and a moderate supply of water at the roots will also be necessary. Syringing overhead in the forenoon should be practised daily, until the flower buds begin to colour, when it ought to be discontinued. An occasional application of manure-water will likewise prove highly beneficial. Green fly, which is frequently very injurious to forced roses, must be carefully looked after, and destroyed. Mildew also occasionally makes its appearance; this is best guarded against by preserving a proper amount of ventilation; but should it manifest itself, any plants that may be attacked must be at once removed, to prevent the spread of the disease, and dusted with sulphur. But, in the case of mildews, the common saying that prevention is better than cure, is a fact well proved by experience. Therefore, whilst there are yet no signs of the disease, the soil should be sprinkled with flowers of sulphur, and the air of the house should be occasionally impregnated with it.

When the buds begin to expand, if full-blown flowers are not required at once, the temperature of the pit should be gradually lowered. The plants may then be removed to the greenhouse or conservatory, and from being thus placed in a lower temperature, expansion will take place more slowly, and the beauty of the flowers will be increased, as well as prolonged.

A succession of forced roses may be kept up by introducing plants into heat in January and February; and the autumnals, if cut back to three or four eyes after the flowers have faded, top-dressed with rotten dung, and liberally supplied with liquid manure, will bloom well a second time.

. After flowering, the plants should be gradually hardened off in a cold pit, then potted and plunged in an open situation out of doors, and all flower buds nipped off whenever they appear.

XII.—FLORIST'S FLOWERS.

CHRYSANTHEMUM.—For the decoration of the conservatory or greenhouse in the autumn and winter, few plants excel the Chrysanthemum; and though liable to suffer from frosts at the time of blooming, it can, in the warmer parts of the kingdom, be made to afford a fine display out of doors. The splendid large-flowered varieties at present in cultivation have been obtained from *C. sinense*, a native of China, introduced into this country in 1764; and the Chusan daisy, sent home by Mr. Fortune, has given rise to the dwarf small flowering Pompones, which are scarcely surpassed in point of beauty by their larger competitors. Of the sorts comprised in these classes, the following are some of the best:—

LARGE-FLOWERING.

Aimée Ferrière, silvery white, tipped with pink.
 Alfred Salter, delicate rose.
 Annie Salter, golden yellow.
 Aregina, rosy purple.
 Aristée, pink.
 Auguste Mie, carmine, tipped with yellow.
 Beauty, peach.
 Bossuet, rosy purple.
 Cardinal, bright amber.
 Cassy, orange and rose.
 Chevalier Domage, golden yellow.
 Christine, blush.
 Dupont de l'Eure, orange and red.
 Elizabeth, white.
 Golden Queen of England, golden canary, very fine.
 Julie Lagravère, deep crimson, very fine.
 Léon Lequay, rose and lilac.
 Madame Cammerson, bright red.
 Madame Clos, beautiful lilac rose.
 Madame Leo, white.
 Madame Poggi, chestnut.
 Mount Etna, red.
 Mount Vesuvius, large, fiery red.
 Persanne, golden yellow.
 Pio Nono, red, tipped with yellow.
 Plutus, bright yellow.
 Prince Albert, bright crimson.
 Princesse Marie, light rose.
 Progne, bright crimson.
 Queen of England, blush.
 Ruth, orange.
 Stella globosa, crimson and white.
 Temple of Solomon, yellow.
 Themis, rose.
 Vesta, pure white.

ANEMONE-FLOWERED.

Eclipse, pale yellow.
 Fleur de Marie, white.
 Gluck, bright orange.

King of Anemones, dark crimson.
 Louis, rosy lilac.
 Marguerite d'Anjou, nankeen.

POMPONES.

Aurora Borealis, dark orange.
 Berrol, pale yellow.
 Bijou de l'Horticulture, sulphur white.
 Bob, brownish crimson.
 Brilliant, crimson.
 Cedo Nulli, white, tipped with purple.
 Drin Drin, yellow.
 Duruflet, rosy carmine.
 Fleurette (Plate IV.), violet purple, free bloomer, and very fine for specimens.
 François I. (Plate IV.), reddish orange, very free, and fine for specimens.
 General Canrobert, clear yellow.
 Hélène, rosy violet.
 Ida, canary yellow.
 L'Escarboucle, bright gold.
 Madame Fould, cream white.
 Madame Rousselon, white, tipped with rose.
 Marabout, white fringed.
 Pandora, reddish chestnut, tipped with gold.
 President Decaisne, rosy carmine.
 Requiqui, plum.
 Scarlet Gem, bright red, free bloomer, and very early.
 Sainte Thais, chestnut, tipped with orange.
 Surprise, white, tipped with rose, free bloomer, early.
 Trophée (Plate IV.), rose.

POMPONE-ANEMONES.

Madame Molinie, bright rosy lilac.
 Madame Montel, white, sulphur centre.
 Madame Sentir, pure white.
 Margueridette, rosy lilac.
 Mr. Astie, bright golden yellow.
 Reine des Anemones, white.

Soil.—For striking the cuttings a mixture of sandy loam and leaf-mould, or any tolerably rich light soil may be employed; but to produce a fine bloom the plants require, in the more advanced stages of their growth, soil of a richer and more substantial nature. A compost consisting of two parts of loam, one of leaf or vegetable mould, and one of well decomposed cow-dung, with as much sand as will keep the whole porous, will answer very well; but many dispense with the leaf-mould, and increase the proportion of loam to three parts. The addition of bone-dust, or pounded oyster shells is recommended by Mr. Broome, of the Temple Gardens, and by other eminent growers.

Propagation.—The varieties are propagated by division of the plant, and by layers; but the usual mode is by cuttings and suckers. Division of the roots is best effected in March or April, and fine strong plants for borders may be obtained in this way, but for pot-culture they are increased by cuttings. Layers are sometimes made in August by pegging down the shoots, and covering with light soil,

so as to leave a portion 6 or 8 inches above ground. When rooted, they should be severed from the parent plant, potted in 6-inch pots, and shut up close in a cold frame till established, when air may be freely admitted. They will form small compact plants suitable for the front shelves of the greenhouse. Cuttings may be taken off at any time, and by propagating early, larger specimens and an earlier bloom will be produced, whilst late struck cuttings will afford dwarf plants, and a succession of flower to January. For fine specimens cuttings are generally struck in November or December, in 3-inch pots, plunged in a cold frame during the winter, and shifted in February or March, as soon as the pots get filled with roots, into 4 or 5-inch pots. The plants are stopped when about 6 inches in height; and as soon as the shoots which result from this operation are 3 or 4 inches in length they are likewise pinched. Good plants for ordinary purposes may however be obtained from cuttings taken off in March or April. In making the cuttings stout healthy shoots must be chosen; these having been cut over below a joint, at about 3 inches in length, and the eyes at the base taken out, should be inserted singly in 3-inch pots, watered, and plunged in a slight bottom-heat. They ought to be kept close, and shaded from strong sun for about three weeks, by which time they will generally be well rooted; they may then be potted in 4 or 5-inch pots, using light compost, and plenty of drainage, and when again established, freely exposed to the air. About the middle of May, or as soon as all danger of frost is over, the pots may be placed out of doors, on a dry hard bottom, in a sheltered situation, well exposed to the sun.

Cuttings may also be inserted in the open ground in March and April, and will form good plants by autumn, when they may either remain in the ground to bloom, or be taken up, potted, and removed to the greenhouse. They will not, however, be equal to plants grown in pots. Nice little plants for late bloom may likewise be obtained by taking off cuttings 5 or 6 inches in length from the tops of the shoots in July or August, striking them in slight bottom-heat, potting off in 4-inch pots, placing on a hard bottom, out of doors, and shifting into 6-inch pots when they have filled the others with roots.

Suckers springing from near the surface, with roots attached, afford a ready means of

propagation, soon forming well-rooted plants, and are by many preferred to cuttings, with which their treatment is the same.

After-culture in Pots.—The plants struck in autumn are repotted in April, or as soon as the pots are filled with roots, and again in June, using pots a size or two larger than those previously employed; the spring-struck plants should likewise be shifted when necessary, say in May and June. The whole of the plants should, at this period, be plunged 2 or 3 feet apart, and to about three-fourths the depth of the pots, giving the Pompones a spot shaded from strong sun. About the middle of July, or sooner if the pots are well filled with roots, the plants should be shifted into their blooming pots, plenty of drainage being afforded. For the large-flowering kinds 9, 11, or 12-inch pots may be used, but for the Pompones varieties 8 or 9-inch ones will be sufficient. Throughout their subsequent growth attention must be paid to syringing the plants overhead night and morning, to watering frequently and copiously at the root, and to turning round the pots two or three times a week, in order to obtain a well balanced growth, as well as to prevent the roots striking into the ground. Staking, pegging down, and tying out the shoots, must likewise be attended to as the plants advance. Stopping should be commenced as soon as the leaders are 6 or 8 inches high, and repeated when the shoots which result are 3 or 4 inches long; but it is not advisable as a general rule to practise the operation after the end of July, otherwise the bloom may be retarded, and suffer in consequence; with the Pompones, however, there is less danger of this being the case. Weak liquid manure may be given early in the summer, and increased in strength and frequency as the buds appear, discontinuing, however, when these begin to show colour. The large flowering kinds, when fine, rather than numerous blooms are required, must have their flower-buds thinned out to one or two on each stem, preserving, of course, the strongest and healthiest buds. In the end of September, or beginning of October, the plants should be removed to a cold pit, from which they may be transferred to a cool greenhouse as soon as in bloom, or they may be placed in it at once if more convenient.

Plants in the open ground may likewise be taken up when the buds begin to swell, taking care to injure the roots as little as pos-



DESIGNED BY

BY H. C. COLE

POMPEE CHRYSANTHEMUMS

1 La Gilana 2 Trophée 3 François I 4 Fleurville

sible, potted in large pots, plunged for a few days in a shady situation till established, and removed to the greenhouse, where they will make a good show, though not so fine a one as pot plants.

Whilst under glass, the plants merely require to be supplied with plenty of water, and abundance of air, whenever the weather is favourable. After flowering, they should be cut down to within 3 or 4 inches of the soil, and placed in a cold pit till spring, when, cuttings having been taken off, they may either be divided and planted out in April, or preserved for flowering in pots in the following autumn; but for this purpose young plants are greatly to be preferred.

Culture in Borders.—The early varieties, and especially the Pompones, flower very well in favourable seasons out of doors, though, of course, not in such perfection as under glass, where they are not exposed to autumnal frosts, which frequently injure, if not destroy, the bloom when no protection is afforded. A rich warm border is to be preferred for plantations out of doors, and it should be prepared by trenching 2 feet deep in winter or spring, mixing plenty of well decomposed manure with the soil in the operation. If old pot plants are to be employed, they may be divided in March or April, and planted out 2½ feet apart; the Pompones, however, being of more compact growth, may be placed 2 feet apart. Plants from cuttings struck late in autumn, or early in spring, may be turned out at the above distances as soon as well rooted, taking care to loosen the balls in planting; they will form fine strong plants by autumn. The after management of border plants is, in most respects, the same as that for pot plants; frequent waterings must be given in dry weather, occasionally sprinkling or syringing overhead, and liquid manure should be supplied two or three times a week, commencing in July, and discontinuing when the buds are about to expand. A top-dressing of compost, consisting of rich loam, and thoroughly decomposed manure, may be spread over the bed in July; it will serve to protect the roots near the surface from the sun, and at every watering a portion of the nutritive matters of the compost will be carried down to the roots. Staking, tying, and disbudding the large flowering kinds should likewise be attended to.

Instead of putting out the plants in open borders, they may be planted in front of a

warm wall or paling, and fan trained; in this way a better show of bloom will be produced, and there is the additional advantage that protection can be readily given in frosty nights.

THE HOLLYHOCK (*Althæa rosea*), is a native of China, and has been an inhabitant of our gardens for about 300 years. Formerly the plant was almost invariably propagated by seed; and no care having been taken to perpetuate the variations which thus arose, or to cross them with each other, little, if any improvement, on the character of the flower was effected. The late Mr. Barron, of Walden, however, directed his attention to raising improved varieties, and continuing them; but Mr. Bircham, Mr. Chater, Mr. Parsons, Mr. Paul, and Mr. Roake, have, since Mr. Barron's decease, originated most of the varieties at present in cultivation, probably outstripping by far his most sanguine expectations, for scarcely any of his kinds is up to the standard of the present day. The hollyhock has now risen to the rank of a florist's flower, as well as become a most valuable plant for the decoration of the flower-garden and shrubbery, in the autumnal months, when no garden of any pretension should be without a choice collection of its varieties. This may consist of the following sorts, for the selection of which we are indebted to Mr. W. Paul, of Cheshunt, whose exertions in connection with this flower are so well known:—

- Annie (Chater), flesh white, chocolate base.
- Beauty of Cheshunt (Paul), light rosy red.
- Beauty of Walden (Chater), rosy carmine.
- Black Prince (Gibbon), black.
- Diadem (Downie and Laird), shaded lilac.
- El Dorado (Paul), bright golden yellow.
- Empress (Chater), fawn, apricot base.
- Fearless (Chater), pale creamy fawn.
- General Havelock (Paul), bright scarlet crimson.
- General Windham (Parker), reddish claret purple.
- Honorable Mrs. Ashley (Roake), lilac peach.
- In Memoriam (Paul), crimson maroon.
- Lady Franklin (Paul), deep pink.
- Lady Tarleton (Paul), pearly flesh, white edges.
- Lady Willoughby d'Eresby (Paul), rich cream.
- Lady Middleton (Chater), rosy crimson, shaded with salmon.
- Lemonade improved (Bircham), canary, purple base.
- Lilac Queen (Chater), lilac blush, purple base.
- Memnon (Paul), beautiful light crimson.
- Miss Ashley (Roake), pale creamy fawn.
- Mrs. Oakes (Bircham), shaded salmon.
- Plutarch (Paul), plum colour.
- Pourpre de Tyre (Bircham), rich purple.
- Pourpre Noir (Paul) dark purple.
- Primrose Perfection (Roake), delicate primrose.
- Purple Perfection (Bircham), light purple.
- Queen of Beauties (Chater), rosy peach.

Queen of the Yellows (Paul), clear pale yellow.
 Queen of the Buffs (Chater), pale buff.
 Queen of the Whites (Paul), pure white.
 Saturn (Chater), clear apricot.
 Souvenir (Bircham), purplish rose.
 Veritas (Paul), creamy white.
 Walden Masterpiece (Chater), lemon, shaded with pink.
 Waterloo (Paul), blood red.
 White Globe (Paul) white.

Soil.—For striking the cuttings, a mixture of sandy loam and leaf-mould may be employed; and when rooted, they will grow well in good sandy loam. For the final plantation a rich loam is the best; but the plant will succeed well in any good garden soil well exposed to the sun. Previous to planting, the ground should be dug two spades deep, and if of a poor nature, some well decomposed manure ought to be incorporated with it.

Propagation.—The hollyhock is propagated by seed, division of the plant, and cuttings.

Raising from seed is only practised to obtain new varieties, and where a large number of plants is required for the decoration of shrubberies. The seed should be saved from the finest sorts, and sown out of doors in June or July, in an open situation, and before winter the seedlings should be taken up, potted, and placed in a cold frame. The seed may also be sown, as soon as ripe, in pots or pans of light rich soil, placed in a slight bottom heat. When the seedlings have made two leaves, they may be potted into 3-inch pots, kept close till again established, and then hardened off and placed in a cold frame. In either case the young plants should remain in the cold frame during the winter, shifting into larger pots when necessary, and they may be planted out in the end of April.

Division of the roots is effected after flowering, but plants from cuttings are generally preferred to those obtained in this way. In performing the operation, each crown should be separated into two or three parts, preserving to each of these at least one bud, and as large a quantity of roots as possible.

The usual mode of propagation is by cuttings, which may be taken off nearly all the year round, those struck in summer and autumn blooming early, and those put in during the spring, late. The cuttings are made from the young shoots; these are taken off close to the old root as soon as they are 2 or 3 inches in length, potted singly and firmly in 3-inch pots, watered gently, placed in a cold frame, shut up close, and shaded from sun. After a

week a little air may be admitted; and when well rooted, the young plants may be freely exposed to the air, whenever the weather is favourable. In the case of varieties difficult to strike, and when propagation is carried on between October and March, a gentle bottom-heat should be applied.

Another mode of propagation much practised by nurserymen, consists in taking off the side shoots close to their base as soon as they begin to get firm in July, August, or September, and cutting them into as many pieces as there are eyes. The leaves, with the exception of a portion of the leaf-stalk, having been removed, the pieces are planted in light mould, either horizontally, and covered with soil to the depth of an inch, or vertically; a hand-glass should then be placed over them, and care must be taken to shade from strong sun. When struck they ought to be potted in 3-inch pots and placed in a cold frame.

After-culture.—At whatever period of the season the plants may have been propagated, they ought to be kept near the glass in a cold frame during the winter, plenty of air and but little water being given. Particular attention should be paid to shifting as the pots become filled with roots, for, observes Mr. Paul, *if large flowers and handsome spikes of hollyhocks are wanted, the plants, when in a young state, must never be allowed to become pot-bound*; an abundance of water should also be given in May and June, the period when their large porous leaves are in the most active state. In the course of March the plants may be gradually hardened off. Those for early bloom may be planted out, where they are to flower, in the middle or end of April, according to the season and locality, whilst those for late bloom may be put out a month later. If planted in masses, a distance of 3 feet every way may be allowed between hollyhocks; if in rows, these may be 4 feet apart, and 3 feet from each other in the row. After planting, a flower-pot should be placed over the plants at night till all danger of frost is over, and copious waterings given in dry weather.

Strong growing plants may be allowed to send up two, or even three flower-spikes, and the weaker ones not more than one; all side-shoots should therefore be removed as they appear. These will prove useful for cuttings. When the plants are a foot high, strong stakes must be driven into the ground so as to be

about 3 feet above the surface, and to these the flower-spikes should be tied as they advance. In the case of flowers intended for exhibition, the spikes are topped when they reach the height of 7 or 8 feet, the flower-buds thinned, so as to leave no more than sufficient to cover the spike when they expand, and the bloom protected from sun and rain for a week or ten days before exhibition.

After flowering, the spikes are cut down to within 6 inches of the ground, and, at the approach of winter, the plants should be taken up and placed in a cold frame till April; but if the soil is tolerably dry, the roots of all, except choice varieties, may remain in the open ground.

THE CARNATION (*Dianthus Caryophyllus*, L.).—The species from which the varieties of this flower have originated having been found wild in England, is generally considered to be indigenous, but many suppose that it was introduced from Italy. However that may be, the carnation has been cultivated in our gardens from a very early period, for Chaucer, who wrote in the fourteenth century, mentions the clove carnation, or girofler, as it was then called. This name, derived from the French *girofler* (clove), was no doubt given in consequence of the powerful spicy aroma of the flowers, and it afterwards became corrupted into gillyflower, or Julyflower. It may, however, be remarked, that these appellations are thought by some to have arisen from the circumstance of the plant flowering in July.

The varieties are extremely numerous. Rea, in 1676, gives the names of 360 distinct sorts of all classes, and at the present time upwards of 200 are grown in the nursery of Mr. Turner, of Slough. They are divided into *bizarres*, *flakes*, and *picotees*. *Bizarres* are those in which the white ground colour is striped with two colours, one of which is darker than the other. *Flakes* are those in which the ground colour of the petals is striped with only one colour—purple, scarlet, or rose. *Picotees*, instead of being striped, have the petals edged with various shades of red, purple, rose, or scarlet, the band of colour being more or less dense, and of greater or less breadth, in different varieties. The *picotee*, it may be observed, is always spoken of by florists as if it were a distinct plant from the carnation, but both may be raised from seed produced in the same seed-pod, and both require the same treatment.

Propagation.—The carnation is propagated by seed, layers, and occasionally by pipings. Seed may be sown in May, in pots or pans of light mould, covering thinly with finely sifted soil. After sowing, the pots should be placed out of doors in a position where they will be shaded from strong sun, and care must be taken to keep the soil sufficiently moist. When the young plants have made six leaves they may be planted out, 6 or 8 inches apart, in beds where they are to remain for blooming, which they will mostly do in the following season.

Layering is the usual mode of propagating established varieties; it is performed in the end of July, or first fortnight in August. The plants should be well-watered at the root a day or two before, the lower leaves of the shoots intended to be layered cut off, and some light sandy mould spread round the plants for the layers to root in. Each shoot is cut half through a little below the third joint from the top, and the knife having been gently inclined to one side, an incision is made along the middle of the shoot to the distance of about half an inch from the joint, so as to form a tongue, the portion of which extending beyond the joint is then cut off. The layer is next bent down to the ground, care being taken to keep the tongue separate from the rest of the shoot, fixed in that position by means of a small hooked peg, and the lower portion covered with soil to the depth of 1 inch. Afterwards the layers merely require to be watered occasionally through a fine rose, and in the end of September or beginning of October they may be severed from the parent plant close to the joint at which they were layered, and potted singly in 3-inch, or two in 4 or 5-inch pots. Pot rather firmly, use plenty of drainage, and place near the glass in a cold frame, keeping close for five or six days. After that time a good watering may be given, and air admitted gradually at first, but afterwards freely.

Pipings are taken off as soon as the young shoots are sufficiently long, in the last fortnight in June or first week of July. When the operation is deferred to a later period than this, the plants have not time to become properly rooted before winter, and seldom bloom well the following season. For striking the pipings, a slight hotbed should be made up, and covered with 5 or 6 inches of light sandy soil, mixed with leaf-mould. For making pipings, short jointed shoots are to be pre-

ferred. These, having been cut off close below the second or third joint, and the bottom pair of leaves removed, are planted $\frac{3}{4}$ inch deep and 2 inches apart, or even closer, if a large number is to be struck. In planting, the soil ought to be pressed round the pipings; and after they are put in a gentle watering should be given. When the foliage has dried, they may be covered with a frame and sashes, or with hand-glasses. Afterwards they must be kept close and shaded from bright sun; but if any of them are suffering from damp, air should be admitted in order to dispel it, and, at the same time, all decaying leaves must be picked off. Excessive dryness has likewise to be guarded against; a gentle watering should therefore be given whenever it appears necessary, taking care, however, that the foliage is dry before they are again shut up. As they become rooted air may be admitted, and the quantity gradually increased till at length they are fully exposed. As soon as sufficiently rooted they should be planted out, 6 inches apart, in a nursery bed, where they may remain till the time for potting arrives, in September or October.

Soil.—The carnation thrives best in a fresh loamy soil, not too strong, and but moderately enriched. Innumerable composts have been recommended for the growth of this plant, but most of them are of a very complicated nature, and by far too rich. Perhaps the best soil that can be employed consists of three parts loam, from an old pasture, laid in a heap for a year or more, and frequently turned, and one part well decomposed cow or stable manure, the whole well mixed six months before it is required, and occasionally turned in the interval. For some time previous to use it should be kept dry; it ought also to be carefully examined to see that it contains no wire-worms, for these would quickly destroy the plants.

General Culture.—The plants after having been potted are kept in a cold frame during the winter. Air is freely admitted night and day whenever the weather is favourable, the sashes being drawn completely off in fine days. About the beginning of December it is advisable to plunge the pots up to the rims in coal-ashes to protect the roots from frost. Early in March the plants must be shifted into their blooming pots, the strongest being potted first. Three plants placed in an 11 or 12-inch pot present the finest appearance when in

bloom; or two may be potted in a 9 or 10-inch pot. In potting, plenty of drainage should be used, and it is of the utmost importance to press the soil very firmly into the pots and round the plants. After potting, those which require support must be secured to small sticks, and the whole of the plants should be placed on a dry hard bottom, in a warm, sheltered situation. If, however, the weather prove unfavourable at the time of potting they ought to be placed in frames, or to be protected with inverted flower pots or hand-glasses till all danger of severe frost is over. Before the plants have grown much, sticks or pieces of wire about 4 feet in length should be inserted for the support of the flower-stems. All shoots, except the leading one, which are likely to run up for flowering must be regularly stopped; water given when necessary; the surface of the soil stirred when it becomes hard; and the flower stems tied to the sticks as they lengthen. About the beginning of May the surface of the soil in the pots should be cleaned, and a top-dressing of decayed cow-dung and loam applied. After this has been done, disbudding ought to be proceeded with. The extent to which the removal of the buds may be carried will depend on the habit of the plants, and the purpose for which they are grown. On weak growing sorts some eminent florists only leave one bud, on strong growers seldom more than two or three, but when the blooms are not intended for exhibition a greater number may be allowed. When the buds have nearly attained their full size, they should be tied round the middle with a piece of bass to prevent the calyx from bursting; and this ligature must be frequently examined, and loosened when it is becoming too tight. Instead of bass a narrow strip of silk coated with isinglass may be employed, moistening it before it is put on. Attention is likewise paid by florists to assisting the flower in opening, by splitting open the divisions of the calyx with a sharp pointed penknife or fine scissors; but in performing this operation care must be taken not to injure the petals. In order to keep the flowers in shape, as well as to display them to greater advantage, a circular piece of card, with a hole in the centre sufficiently large for the calyx to pass through, having also a slit from the centre to the circumference, is placed beneath each bloom as soon as the external or guard petals have dropped. When the buds begin to open, the plants should be

protected from strong sun and rain by a canvas covering, or in an airy glass structure.

THE PINK.—This delightful flower is by some considered to be derived from the same species as the carnation (*Dianthus Caryophyllus*) whilst others assign it to *D. plumarius* and *D. deltoides*, both of which are indigenous to Britain. It is probable, however, that all these species, and perhaps some others, have contributed towards the production of the many beautiful varieties which are now in cultivation.

The pink succeeds well when planted in any tolerably rich soil, but for the production of perfect blooms a bed should be specially prepared. A mixture of two parts turfy or maiden loam, one of vegetable mould, and one of well decomposed cow-dung, the whole turned several times and thoroughly incorporated, answers exceedingly well. If the loam is of a stiff nature it will be advisable to add sand to render it sufficiently open. The bed should be prepared in August; it may be formed to the depth of 1 foot or 18 inches, according as more or less compost can be afforded, the greater depth, however, being preferable. It ought to be raised as much as 6 or 8 inches above the path, and rounded in order to throw off the rain in autumn. An edging of wood or slate will serve to confine the soil of the bed within proper limits.

The pink is propagated by seeds, layers, and pipings, the latter method being that generally adopted; and the modes of proceeding are exactly the same as in the case of the carnation.

Planting is performed in September, and ought never to be deferred later than the beginning of October, otherwise the plants will not be well established in the ground before winter, which is a matter of the greatest importance. The distance allowed between the plants may be from 8 to 10 inches. Afterwards it is merely necessary to water in dry weather, and to stir the surface of the soil when this becomes too hard. In the middle or end of March the edges of the bed should be made up so that it may be nearly level. An inch of well decomposed manure should then be spread over the surface, into which it may be lightly forked early in May.

When the flower stems shoot up, thin them less or more according as the plants are of a strong growing habit, or the contrary. Florists only allow one flower stem to weak plants, and seldom more than four to those which are vigorous; but when the plants are grown for

ordinary flower garden decoration this need not be attended to; the side buds should, however, be removed. Weak liquid manure may be occasionally given at this period; in all other respects the treatment should be the same as for the carnation.

PANSY or HEARTSEASE.—The numerous varieties of this interesting and popular flower have been obtained from *Viola tricolor*, a native of Britain, by sowing the seed and hybridizing with other species of the same family.

For ordinary flower garden decoration the plant may be grown in any cool border, but where choice varieties are cultivated a bed must be prepared for the purpose. A situation shaded from the mid-day sun, but not overhung by tall trees or shrubs, is the best. The site of the bed having been decided on, 1 foot or 18 inches of the surface soil should be removed, and replaced with a compost of sandy or decayed turfy loam, leaf-mould, and rotten cow-dung, the whole thoroughly incorporated, laid in a heap for some months previous to use, and occasionally turned. The proportions of four parts loam, one leaf-mould, and one dung will be found to answer well either for culture in beds or in pots. If the loam is rather stiff as much sand should be added as will serve to keep it open.

The heartsease is propagated by seeds, cuttings, and occasionally by layers. Seed may be sown at any time when the weather is sufficiently mild, but preferably in April or May, and in August and September. The sowing should be made in pans of light rich soil, either in gentle heat or in a cold frame, and the seeds covered lightly with fine soil. As soon as strong enough the seedlings should be planted out in a cool border, but if they have come up so late in the season that they cannot get well established before winter, it will be advisable to keep them in store pots in cold frames till February or March. As soon as the plants come into bloom the most promising should be selected for propagation, and the rest discarded.

Cuttings may be struck at any period of the season, but with the greatest facility in spring and autumn; where it is desired to keep up a good stock the work of propagation should, however, be carried on throughout the summer. In this way, also, a succession of bloom will be produced, the spring struck cuttings coming in for late bloom, the summer ones for late and early flowering, and those put in in

autumn, for succession. For cuttings, side shoots about 2 inches long are to be preferred, and if springing from beneath the soil and partially rooted so much the better. These may be planted in light sandy soil, in a cool shady border, and covered for a few days with a hand-glass; but if taken off in spring or autumn, they ought to be put in round the edges of 5-inch pots in a frame, where they should merely be shaded from strong sun. When rooted, they may be planted out in nursery beds of light soil till the time for final planting arrives; it is safest, however, to pot up the general stock in October, and place it near the glass in a cold frame, where the plants may remain till March, merely protecting from frost, but giving them all the air possible.

Culture in Pots.—For flowering in pots, vigorous plants should be selected, and these having been potted in the end of September or beginning of October, in 4 or 5-inch pots, with plenty of drainage, are placed near the glass in a cold frame with a south aspect. As much air and light are given as possible, the sashes being drawn off in fine days, but kept close and covered up in frost, and water is supplied in moderation in mild weather. Early in February the plants are shifted into 6 or 8-inch pots for blooming, using plenty of drainage, removing the old surface, and loosening the sides of the ball. Water is withheld for three or four days. Afterwards, as the plants progress, attention is directed to thinning, pegging, and tying out the stems; and as they begin to show bloom weak liquid manure may be given with advantage two or three times a week to such varieties as are not apt to become over-luxuriant, and produce coarse flowers. In May the frames should be turned so as to face the south and render less shading necessary.

With regard to flowers intended for exhibition, the treatment in other respects is the same as in beds; but where the plants are to be shown in pots, the buds are removed till about three weeks previous to the day, in order to have all the stems in flower at the same time.

Culture in Beds.—Plants intended for early flowering may be planted in the blooming bed in the end of September or beginning of October; those for succession in the end of February or in March, according to the season and state of the ground; and those for autumn bloom in a cool border in July. The distance

between the plants may be 10 or 12 inches for such as are of weakly or medium growth, and 15 inches for those of vigorous habit. After planting, little is required beyond stirring the surface soil occasionally, searching for slugs, which are frequently very destructive, watering freely in dry weather, removing decaying leaves, thinning out the shoots, and pegging down the branches. A top-dressing of well decomposed manure and loam should also be spread over the beds in spring, any vacancies which may exist having been previously filled up. Slight protection may also be given in winter to autumn planted beds, by sticking in spruce branches, or by covering in severe weather with mats. Where fine flowers are required for exhibition, only from two to six main stems are allowed to remain, the side shoots being removed from time to time; and the bloom buds are picked off until about three weeks before exhibition, whilst the beds are shaded from strong sun, wind, and heavy rain by a calico covering.

THE AURICULA—(*Primula Auricula*, L.)—a native of the Alps, has long been cultivated in this country, and prized by florists as one of their finest flowers. The date of its introduction is, however, unknown, but it must have been prior to 1597, when the plant was described by Gerard, who mentions several sorts of Bear's Ear, by which name the auricula was formerly known, as being then commonly grown near London. Since that time, great improvements have been effected in the flower through the efforts of florists, and the active competition which exists amongst the operatives in the great manufacturing towns, who have carried the culture of this plant to a high degree of perfection.

In the language of florists, a single flower is a *pip*, and several of these borne on the same flower stem, constitute a *truss*. The individual pip is divided into four parts, the sexual organs in the centre or tube of the flower, called the *thrum*, the circle of white surrounding this, called the eye or *paste*, the next external band, which should have a feathery edge, termed the *ground colour*, and the margin or *edge*. According to the colour of the edge the varieties are divided into *Green-edged*, *Grey-edged*, and *White-edged*, and those which have no edge or distinct band of colour external to the ground colour, constitute a fourth class termed *Selfs*. Besides these there is another division, the *Alpines*, in

which the paste is yellow instead of white, whilst the portion of the flower external to the paste does not consist of ground colour and edge in distinct zones, but of a mixture of colours; such varieties are, however, but little cultivated by florists.

Propagation.—The auricula is propagated by seed for the production of new varieties, and by division of the plant for the perpetuation of the identical sorts.

The seed may be sown soon after it is gathered in August or September; but sowing in January, February, or the early part of March, is preferable, as the seedlings in this case do not require so much protection, and are not so liable to damp off as those raised from seed sown in autumn. The seed should be sown thinly in pots or pans well drained, and filled with light rich mould sifted fine. A mixture of sandy loam and leaf-mould will answer very well. Only a thin covering of earth should be given. After sowing, the pots ought to be placed in a cold frame or near the glass in a greenhouse, but in a position shaded from strong sun; and a proper degree of moisture should be preserved in the soil by gentle waterings, or by a slight covering of moss kept over the surface till the seedlings come up. Care should be taken in giving water not to wet the foliage; and when the young plants have made 3 or 4 leaves, they may be transplanted into 3-inch pots and hardened off; some, however, plant out 6 inches apart in a shady border, as soon as the weather will permit. In the following season many of the seedlings will bloom, and when this takes place, those which offer a favourable prospect should be picked out, and the rest dispensed with.

Propagation by division is best effected in the end of February or beginning of March, though the operation may be performed in the beginning of August, if repotting at that period is adopted. The offsets or suckers are taken off between the finger and thumb, or with a blunt knife, taking care to disturb the roots as little as possible, and finely powdered charcoal is placed on the wounds. The offsets should then be potted in 3-inch pots, or in threes round the edges of 5-inch pots, using light loamy soil with a plentiful admixture of leaf-mould and silver sand, and placed in a cold frame till again established. A writer in the *Midland Florist*, 1854, p. 342, states that he has often successfully practised

the following mode of propagation, in the case of varieties that do not readily produce suckers. He says, "When I repot, about the first week in August, those with long tap roots I cut well back; the part of the root I thus cut from favourites, I pot, leaving nothing but the cut part above the earth. I then give them a little water with a syringe or watering-pan; and in two or three weeks perhaps as many buds will make their appearance round the old root. These grow very fast, and may be potted singly in autumn or spring, according to their size."

Soil.—Maddock, Emerton, and many other authorities on the cultivation of the auricula, recommend excessively rich composts for the growth of the plant, which, when thus highly fed, generally perishes; for the consequences of over-feeding in the vegetable as in the animal kingdom, are disease, and most frequently premature death. At the present day, less stimulating mixtures are employed. Dr. Horner, of Hull, an eminent cultivator of this plant, considers the most suitable soil to be two parts pasture sods two years old, one part cow-dung three years old, and half a part of coarse river sand; and to this compost he adds in potting a small quantity of partially decayed leaves. Good rich loamy soil from an old pasture and old frame dung will, he observes, be good substitutes for sods and cow manure, and should be used in the same proportions. The late Mr. Dickson, of Brixton, employed a mixture of one-third Norwood loam, one-third peat and leaf-mould in equal quantities, and one-third rotten dung.

Mr. Staton, of Ruddington, near Nottingham, uses a compost consisting of one barrow-load of decayed sandy turf two years old, one barrow-load of rotten sheep's dung, and about half a peck of stick ashes; these ingredients must be mixed together two months previous to potting time, and turned over once a-week, so that every part may be well exposed to the sun. Afterwards it is sifted through a fine sieve.—(*Midland Florist*, 1847, p. 13.)

Mr. Lightbody of Falkirk has used for many years a compost of two barrow-loads of cow-dung at least two years old, one barrow-load of leaf-mould, and one of pure light loam from an old pasture. These are intimately mixed together, and a sufficiency of fine silver sand added to keep the mass open and insure drainage. He contrives to have it all frozen through during the winter by removing the

frozen surface and placing it under an open shed, where it remains till wanted.

Mr. Cooke, of Coventry, another successful cultivator, states, that the auricula thrives and colours well in a mixture of one-half old hotbed manure, and one-half sound fibrous loam, well turned over and frozen through before being used. He has found charcoal or wood ashes preferable to sand in the compost, as these substances not only keep the soil open, and therefore sweet, but also help to fertilize it.—(*Florist*, 1853, p. 93.)

General Culture.—Although the auricula may be grown in a shady border, yet the finer varieties can only be flowered in perfection in pots and under protection. For this purpose a cool frame or pit is generally employed; but a frame specially adapted for the plant is preferable. There are several such contrivances in use; one of the best is that devised by Dr. Horner. It stands on legs between 2 and 3 feet high, and is open at bottom. The back is of wood, and there is a door in it for access to the plants and for the admission of air. The ends and front are of glass, the former are fixed, and the latter, being hinged to the frame, can be let down at pleasure for giving air. The top is protected with sashes, which can be tilted or entirely removed when it is desired to completely expose the plants. In the interior there are five rows of shelves, the rise between which is 2 inches, and the distance from the glass 15 inches. Each shelf is 5 inches in breadth, and a piece about 1 inch in width is cut out along the middle to within a short distance from each end, to permit the water to escape from the pots. The dimensions are:—height from the ground at back, 4 feet 8 inches; in front, 3 feet 8 inches; width, 3 feet 8 inches, and length 7 feet 2 inches.

Where a frame like that above described is not at command, the plant may be successfully grown in a common garden frame, care being taken to pave or concrete the bottom, and give it a proper slope to allow moisture to run off. If, in addition, a portion of the front and also of the back of the frame were hinged, so that they could be let down to give air in wet weather, it would greatly add to the convenience of the structure, and materially contribute to the preservation of the health of the plants.

The season of growth in the auricula is from February till June; active vegetation is then

suspended till the beginning of August, when it is resumed, continuing till about the middle of October, from which time till February, the plant remains in a state of rest. With regard to the culture during these periods, much difference of opinion exists, and many modes have been recommended; but in our opinion no directions are plainer and better than those of Dr. Horner, who says:—"The pots for a full-sized plant should not exceed 4 inches at the top, and 3 inches at the bottom, inside measure; they should also be made $5\frac{1}{2}$ inches deep, to allow of abundant drainage, and should not be hard baked, but left as porous as possible. It is a great and almost universal fault to use pots of too large a size. The best time for potting is immediately after the plants have bloomed; for on account of the long previous confinement in the frame, the frequent waterings, and the excitement of blooming, the auricula is very apt to contract disease, especially rot or decay in some part of the main or tap-root, as it is called. This, in repotting, is at once detected, and consequently the life of the plant saved. Moreover, by early potting, ample time is given for the pot to get well filled with young healthy roots before the approach of winter—the great secret of a vigorous bloom the following spring; *neglect of yearly repotting is a great evil*. The important operation is thus performed:—first, put at the bottom of the pot at least $1\frac{1}{2}$ inch of crocks of broken garden pots; on these place a thin layer of decayed leaves unbroken up; they prevent the soil from filling up the interstices between the crocks, and, moreover, furnish a most acceptable nidus for the roots of the plants. Next, fill up the pot within about 2 inches or so with the compost, leaving it slightly cone-shaped; on the top of the cone put a little sand, on this place the end of the tap-root, and, having disposed the roots regularly over it, let the pot be filled nearly to the brim, so that the soil just covers the insertion of the lowest leaf. Now strike the pot smartly two or three times on the ground, and then remove it to its summer quarters, when water must be given, just sufficient to moisten the soil, and repeated at the end of a week, not before. In filling the pot with compost, I always put in about three fingers' full of decayed or rather decaying leaves, not leaf-mould—a pinch here and there. In repotting the following year, an unusual mass of roots will

be found surrounding and piercing them through and through; they at once afford most acceptable nourishment and drainage. Previously to the operation of potting, the plant must be prepared by carefully crumbling off the old soil with the fingers, and then washing the roots in water, in order that any decay or disease may be detected, in which case it should be effectually cut out with a sharp knife, and the main root should then be shortened to within 1 inch of the leaves, leaving only the young and new fibres or roots. One great and fatal cause of the dwindling and disease of auriculas is the leaving too long a tap root; it will most assuredly decay and kill the plant. When it is desired to save seed, the operation of potting must be delayed till August.

"The summer situation of the auricula is all-important. As it naturally delights to grow in open and elevated regions, as on the Alps, so its place and position in the garden must be comparatively high and of free exposure. The pots should stand on planks, which are raised 2 feet from the ground, and placed by the side of a wall or hedge having a north-east aspect, and without awning or covering. Here they may be safely left till November; for if they are annually repotted, properly trimmed at the root, have sufficient drainage in the pots, and if due attention, moreover, be given to them from time to time (as by carefully twisting off decayed leaves, stirring the surface soil occasionally with the point of a knife), the much-talked-of rot need not be dreaded; but if these directions as to potting, just described, have not been followed, and the plants have not been elevated on planks the required distance from the ground, and consequently left in the usual susceptible state of disease, by all means let a temporary awning be erected over them if the summer prove wet.

"In November, they may be placed in the frame, giving them all the air possible, as by letting down the front lights and opening the door behind—the top lights being kept on in case of rain. Watering must be gradually withdrawn, so that during December and January the soil be just kept from being absolutely dry; if it be kept wet or damp, the plants will be in great danger of contracting disease, and of suffering from frost. In winter, during intense frost, the frame must be protected with efficient covering; two

stout blankets, with an outer coverlet of tarpauling, I have found the best, and, in the end, the cheapest materials. If not protected from severe frost, many of the flower-stems will be found dead, or with only two or three pips at the blooming time. In winter, during milder days, the plants should have sufficient air.

"About the end of February, and during March, they must have all the air possible, and also should be exposed, by removing the top lights, to frequent gentle showers; nothing is so invigorating. They must now also be top dressed with a compost of two parts cow manure, and one part loam, having previously removed the old soil to about the depth of 1 inch. At the beginning of April, when they have pushed up their flower stems, they must not longer be exposed to showers of rain, but the soil must, to the end of the blooming season, be preserved in a moist state. As the pips, if frosted when about to expand, will never bloom flat, the frame must be carefully protected, as just described, every night. In watering the plants, great care must be taken to avoid the foliage; and if a drop has accidentally fallen into the crown of the plant, it must be extracted by means of a camel-hair pencil, or decay will probably be induced. A small watering-pot, with a spout $1\frac{1}{2}$ foot long, bent at the end, and then contracted to the diameter of a goose-quill, should always be used for the purpose of watering.

"When the pips are just expanding into bloom, the frame, which has hitherto been exposed to a southern aspect, should be removed into the shade; or what is more feasible, the plants may be placed under hand-glasses, in a calm and shaded part of the garden, air being admitted at the bottom. The best plan, however, is to remove the plants into a common garden frame, placed in a shaded part of the garden, with the benefit of two hours morning sun. The pots are not placed on the ground, but on shelves, graduated according to the fall of the glass lights. Slide doors are made in the front and back of the frame, by which means any quantity of air can be admitted freely, to circulate around the bottoms, sides, &c., of the pots and plants; it is most injurious to admit air in the common way, by tilting up the glass lights, as the cold air is thus suffered to blow directly upon the expanding blooms; hence the very great advantage of the contrivance just described.

As the pips expand, the smallest, least perfect, and overcrowded ones must be carefully thinned out, leaving a truss of five, seven, or nine. When in full bloom, the plants may be removed to any other situation the grower may fancy, as to a cool, airy greenhouse, where their beauties can be more conveniently seen and examined."—(*Gardeners' Chronicle*, 1841, p. 397.)

Mr. Lightbody, of Falkirk, another eminent cultivator of this plant, pursues a different system as regards potting. "There can be no doubt," says Mr. Lightbody, "but that early potting causes many of the plants to bloom in autumn, which weakens the plants, and injures the spring bloom. My time for beginning this necessary operation is towards the end of July, so that I may have them all finished by the middle of August. The plan I follow is to shift two years consecutively, leaving a good ball of soil at the roots; and the third year to shake the whole of the compost from the fibres, and pot them afresh. When I require to do this, I repot about a month earlier. The method I adopt in repotting is as follows:—For a full sized plant I use a pot 6 inches wide, and 7 deep; and for smaller plants and offsets, pots varying from 3 to 5 inches wide. For draining I use, first, a layer of broken crocks, then a layer of oyster shells, convex side up; above this I place some vegetable fibre, to prevent the compost choking the drainage. I then fill in some compost; when this is done, I examine the plant to be repotted, and reduce the ball of fibres with a sharp knife. I like to grow my plants with short stems; consequently, the lower portion of the stem or carrot is well examined annually, and all decaying portions of it cut off, and the wound dressed with powdered wood-charcoal to dry it up, and keep the plant healthy. The offsets are then slipped carefully off, and the part of the plant to which they adhered dressed also with charcoal; the plant is then placed in the centre of the pot, which is filled up to within about $\frac{1}{2}$ inch of the top, care being taken to keep the foliage clear of the compost; a gentle stroke or two upon the bench will settle the soil, and should it sink much, add the quantity necessary to complete the process. When the compost is shaken altogether from the plants, and the stem and fibres properly trimmed, the fibres require to be equally distributed over the soil in the pot, touching the side, and then filled up. Some cultivators

have recommended keeping the plants in a dry state for a few days after repotting. I have found harm resulting from following this advice; therefore they should be watered whenever completed."—(*Florist*, 1852, p. 33.)

To Save Seed.—For this purpose the most healthy plants of varieties possessing desirable properties should alone be selected. These should be removed from the blooming stock in March or April, and placed on a dry hard bottom, in a shady part of the garden, where there is no danger of accidental impregnation taking place. Here they merely require to be protected from heavy rain, and to be watered when there is danger of the soil in the pots becoming too dry. When the plants bloom, the pips should be thinned, by cutting out some of the weakest, and as soon as the seed ripens, the pods should be cut off as they successively turn brown, and kept in paper bags, in a dry place, till the time of sowing arrives.

When artificial impregnation is resorted to, the anthers of the female parent should be carefully removed as soon as the flower opens, and the pollen applied to the stigma with a camel hair pencil. Afterwards, it is advisable to cover the plants with hand-glasses, or fine net, till all danger is past of accidental impregnation taking place. It may be remarked, that it is almost impossible to save seed pure in gardens where Alpines are grown.

Diseases.—The roots of the auricula, and especially the tap-root, are frequently attacked by the *rot* or *canker*, in consequence of which the foliage changes colour, and the plant droops and quickly perishes. The causes of the disease appear to be deficient drainage, an excessive supply of moisture, want of air, and too rich a soil. On the first indication of disease, the plants should be turned out of the pots, the decayed portions of the roots cut off, the tap-roots shortened, and the wounds having been exposed for some time to the air to dry, the plants should be again repotted in fresh, rather poor soil.

THE DAHLIA (*Dahlia variabilis*, D. C.)—This splendid flower is a native of Mexico, and was introduced into England in 1789 by the Marchioness of Bute, who brought it from Spain. Since then great improvements have been effected in the form, size, and colours of the flowers, which now exhibit almost every shade of red, white, and yellow, as well as an infinite variety of mixtures of these colours.

The dahlia is propagated by seeds, cuttings, division of the roots, and occasionally by grafting. The seed may be sown in the end of March or in beginning of April, in pans filled with light rich soil, and placed in a bottom-heat of about 60°. When the seedlings are about 2 inches high, they should be pricked out in small pots, gradually hardened off in May, and planted out in the beginning of June.

In propagating by cuttings, which is the usual mode, the roots are planted, but without covering the crowns, in February or March, in light sandy mould, either on a hotbed or in large pots or boxes, placed in a moist bottom heat of about 60°. Shoots are soon produced, and should be taken off close to the root, as soon as they are 2 or 3 inches in length, and potted in thumb pots, or in threes round the edge of a 5-inch pot, using light sandy soil, with a layer of silver sand at top. They must then be removed to a gentle hotbed, and kept close, shaded, and watered gently, till they strike root. They may then be potted into 4-inch pots, well drained, and filled with rich soil, and, when established, hardened off, and removed to a cold pit or frame, where they should be kept near the glass, allowed plenty of air, and repotted when necessary. They may be planted out in the end of May or beginning of June, and protected, if the nights are cold, with an inverted flower-pot.

Cuttings of the shoots may also be taken off below a joint in summer, and struck in heat. The plants thus obtained, merely require to be protected from frost in winter, and to be started in heat and repotted in spring.

Division of the roots is chiefly practised where only a few strong plants are required. In this case place the roots in heat in March or April, and when the buds at the crown push, divide into as many parts as possible, preserving at least one bud to each piece. The pieces must then be potted according to their size, and kept in a greenhouse or cold frame till the time of planting out.

Grafting is sometimes performed in autumn, with the view of preserving new varieties, when there is danger of their roots dying in winter. A shoot is taken off just below a joint, one of the leaves cut off, and a portion of the skin removed; it is then inserted into, or applied against a root, from which a corresponding piece has been cut. The graft having been tied up, and covered with clay,

is potted so that it may be covered with the mould, and placed under a hand-glass in a slight bottom heat. After the union has been effected, the grafted roots should be gradually hardened off, and kept in a slow growing state during the winter. They will furnish a good supply of shoots for cuttings on being plunged in a hotbed in spring.

The dahlia, to produce its flowers in perfection, requires a well drained soil, which is neither very light nor of a strong adhesive nature. Any good fresh loam will do exceedingly well. The ground should be prepared by trenching in winter, and if it is naturally poor, some turfy loam and well decomposed cow-dung, or old hotbed mould may be mixed with the soil at the time of planting. Much strong manure, however, is apt to cause canker in the roots, as well as by inducing over-luxuriance to prevent, in a great measure, the production of flowers.

Any open situation, not shaded by trees, will suit the plant. The tall varieties may be planted with good effect on each side of a walk, or in front of shrubbery borders. They also have a most brilliant appearance when planted in masses. The dwarf varieties may be used for bedding in the flower garden, where they are either allowed to pursue their natural mode of growth, or are pegged down.

In the end of May, or first week of June, the plants may be planted out in the open ground. Holes are made 5 or 6 feet apart, according to the height of the variety, and the plants having been turned out of their pots, taking care to preserve the ball entire, are planted a little deeper in the soil than before. A good watering should then be given, and this should be repeated once or twice a week if the weather be dry. To save trouble in watering, some mulch the ground round the stem with grass mowings or litter, but this, of course, cannot be practised in the flower garden or pleasure grounds, on account of appearance. Syringing, or watering overhead, in the evening, through a fine rose, may also be very beneficially practised, if that amount of attention can be bestowed. As the plants advance in height, they should be tied to stakes with matting, and any superfluous shoots removed. Where very fine flowers are desired, the side shoots are also supported by stakes, and the shoots, as well as flower-buds, thinned out, more or less according to the habit of the variety, strong growing large-

flowering sorts, requiring very little thinning, whilst those of a less vigorous growth require to be thinned considerably. Flowers for exhibition are also protected from sun and heavy rain for some days previous to cutting, by shades of tinned iron, wickerwork, or wire covered with calico. When the buds have formed, liquid manure may be given with great advantage once a week.

As soon as the stems are injured by frost they should be cut down to within 6 inches of the ground, and the roots taken up with a fork, labelled with the name of the variety, and turned stem downwards for a few days, to permit the moisture to drain off. When dry, they may be stored in hay, straw, dry soil, or sand, the crowns being left uncovered, in a cool place which is secure from frost and free from damp. There they may remain till propagation is commenced in spring, with no other care than examining them from time to time, and removing any which are rotten, as well as cutting off parts which are beginning to decay.

Earwigs frequently prove very destructive to choice blooms, by devouring the petals. To entrap them, beanstalks may be hung among the branches, or a flower pot, half-filled with moss, or a trap sold for the purpose, may be placed on the top of the stake. These contrivances should be examined every morning, and the earwigs destroyed.

THE RANUNCULUS (*Ranunculus asiaticus*, L.) has long been a denizen of our gardens, having been cultivated by Gerard in 1596. The species is said to be a native of the Levant; and it has given rise to a multitude of varieties, chiefly of Dutch and British origin, presenting a rich diversity of colour.

Propagation.—The ranunculus is propagated by seeds and division of the roots. Seed is saved from the semi-double flowers, and may be sown in September and October, or in February. The sowing should be made in pans filled with a compost of light sandy loam and leaf-mould, scattering the seeds rather thinly, and covering with about a tenth of an inch of finely sifted mould. A gentle watering having been given, the pans may be placed in a cold frame, where air must be freely admitted at all times, except in frosty weather, and the soil moistened if it is likely to become too dry. In a month or six weeks the seedlings will appear above ground; afterwards they merely require attention in respect to

watering and shading. About the middle of May the pots or pans ought to be plunged to the rim in a sheltered border which is exposed to the morning sun. When the foliage begins to wither the plants should be protected from rain, water at the same time being withheld; and, as soon as ripe, the roots should be taken up, dried, and kept in drawers, or in paper bags in a cool dry place. In the following year the treatment is the same as in the case of established sorts; and in this and the succeeding year the plants will show flower, when those which possess desirable properties in size, form, and colour, should be marked for preservation.

In propagating by division, it is merely necessary to clean the roots after taking up, and separate the offsets before these are completely dry.

Soil and Situation.—A moist open situation with a retentive subsoil, free, however, from stagnant water, is the most suitable for the ranunculus bed. Some recommend a position shaded from all but the morning sun; but in this case there is danger, in cold wet seasons, of the roots not arriving at a proper degree of maturity, and therefore not keeping well. The soil of which the bed is formed is a matter of the greatest importance, and it should be procured several months previous to its being required for use. A rich, friable, but retentive loam, such as the top spit of a pasture, free from wireworm, is the best. To every two parts of this, one of well decomposed cow-dung, at least one year old, should be added, and the whole having been thoroughly incorporated, it ought to be placed in a heap, and occasionally turned.

The proper time for forming the bed is in August or September; and if, from unavoidable causes, the operation must be delayed, it should be performed as soon after that period as possible, in order that the soil may become consolidated, and undergo the action of the weather before planting. The natural soil having been dug out to the depth of 2 feet, and the bottom levelled, the compost is filled in to within 3 inches of the surface, and levelled. The compost should be allowed to settle during three or four weeks; it must then be brought up to its original level, and a layer of light mould, 3 or 4 inches thick, added, so as to raise the surface of the bed about 1 inch above the level of the path, or surrounding ground. The bed should next be

surrounded with an edging of stone, slate, wood, or any other material that will not harbour slugs, and that may suit the means and taste of the cultivator. Afterwards it is merely necessary to rake the surface level, to keep free of weeds, and to make up with light soil any subsidence that may take place.

Planting.—The Turban varieties may, in favourable seasons, be planted in October, but it is safer to keep the other sorts out of the ground till spring. The best time for planting these is about the middle of February. “At this time,” says Dr. Horner, “the ground is moist, the roots rapidly vegetate, and become firmly fixed in the soil. Whereas, if deferred till March, arid winds are apt to prevail, the soil becomes dry, the young roots lack moisture, are injured, and unable so to establish themselves as, at future periods, to afford sufficient nutriment to throw the plant into bloom. The bed being about 4 feet in width, and any suitable length, and having been neatly smoothed over, the roots should be planted about 5 inches distant from each other, in rows, which again should be about 6 inches apart; if planted closer, as is commonly the case, the plants will grow comparatively weak, and bloom more sparingly. The situation of the rows having been marked out, holes $1\frac{1}{2}$ inch deep should be dibbed with the finger, or other instrument, in which the roots should be compactly set, and covered over with soil after the manner of dibbling beans, so much approved of by agriculturists; by this means the surrounding soil is not disturbed, but left close and retentive. The next best plan is drawing drills across the bed in rows, setting the roots therein, and then filling them up with the displaced soil; the worst of all plans being the raking the bed evenly over, setting the roots on it, and then covering the whole $1\frac{1}{2}$ inch with loose soil; yet this is commonly practised.

General Management.—“About the beginning of April the young plants will appear above ground, when the loosened soil should be carefully, yet firmly, compressed with the fingers about the roots. During the months of April and May, should a continuance of dry weather prevail, water may be cautiously administered at intervals in an evening, but only just so much as will prevent the soil of the bed from cracking; or a little moss, or old spent tanners’ bark, &c., may be neatly placed between the rows, which will retain

the moisture in the soil. The injudicious and over-abundant application of water is a very common error, and one of the greatest evils. It not unfrequently happens that plants, which have looked well for a time, at length begin to turn yellow in the foliage, and the flower-buds dwindle and go off. This, indeed, is a very common cause of complaint and disappointment; it is chiefly attributable to the practice of deluging the bed with water between the rows in hot dry weather. The roots absorbing the large supply of water thus artificially afforded to them, transmit it in abundant quantities to the leaves, which are now excited by the hot and dry atmosphere to greatly increased exhalation. This unnatural excitement at length weakens and destroys their vitality, and they perish. Hence the common and trite caution, to water only between the rows, and not on the foliage, lest it should thereby be turned yellow, is founded altogether on a mistaken hypothesis. The dying of the leaves, in some instances, evidently depends on a want of vigour, or partial rot in the root; and in some few cases it would appear to be caused by large earthworms forming their wide tracks amid the roots of the plants, nearly undermining them; but in the great majority of cases it is produced by injudicious watering, as just explained. During the expansion of the flower-buds, and when they are fully blown, a stage and awning should be erected over the bed, as in the case of tulips, that rain and hot sun may be excluded; and gentle waterings, every second or third evening, may be given, which will keep the bed cool and moist, and promote the size of the flowers. As much air should be admitted as possible, that the flower-stems be not drawn up and weakened.

“*Taking up the Roots.*—Of all the points in the cultivation of the ranunculus, this is the most vital and important. The tubers are extremely apt to start, or put forth roots again, if allowed to remain too long in the ground; this fatal event being most liable to occur under the influence of heat and moisture. Hence, if the weather be showery, the top awning should never be removed till the stalks and foliage of the plants have turned yellow, indicating the proper period for taking up the roots. When they have put on this appearance they should be at once harvested. If the tuber has again vegetated it will either grow weakly or, in all probability, perish when

planted the following year. But though the young roots may not always be visible to casual observation, if but an impetus be given—an effort, as it were, to grow, be induced—there will be a failure in the bloom the following summer, the root being weakened and injured by its previous attempt at growth. When taken up, they should be kept in a dry yet airy apartment, being very liable to contract mould. A proper cabinet should be provided for the purpose, or they may be kept in partition drawers, or hung up in paper bags.”—(*Gardeners' Chronicle*, 1842, p. 420.)

To the above excellent directions little can be added, except that the roots should be taken up successively as they ripen. By pursuing an opposite course, many of them will start into fresh growth and be destroyed. When there is danger of the roots not ripening, Mr. Lightbody, of Falkirk, an eminent cultivator of this flower, has successfully adopted the practice of cutting the fibres a few inches below the surface, and slightly raising up the root with its surrounding ball. In this way, he states that he has saved many valuable seedlings which would otherwise have been assuredly lost, whilst no evil effects have resulted to the plants from the operation.

THE TULIP (*Tulipa Gesneriana*, L.)—This splendid flower, a native of the Levant, appears to have been introduced into Britain about the year 1577, and its culture soon afterwards was enthusiastically pursued both in this country and in Holland. To such an extent has the rage for tulips at times been carried that in 1809 a single bulb of one variety sold at £300, and of another for £100: and in 1818 one sort was quoted at £500. Even as recently as 1854 the catalogue of the late Mr. Groom of Clapham contained the names of three varieties, the price of which was 100 guineas each.

The varieties, of which there cannot be less than 500, are divided into three classes—*Bizarres*, *Byblœmens*, and *Roses*. *Bizarres* have yellow grounds marked with another colour; *Byblœmens*, a white ground marked with various shades of black, violet, or purple; and *Roses*, a white ground marked with some tint of red. Each of these classes is again divided into *feathered* and *flamed* flowers. In the former the colour is entirely disposed towards the edge of the petals, whilst in the flamed it forms, either with or without the feather, a broad stripe, or beam as it is technically called,

which proceeds from near the base towards the other extremity of the petal, generally ramifying as it goes.

Propagation is effected by seeds for new varieties, and by offsets.

The seed is not fit for gathering till the pods begin to open, when these should be cut off with 5 or 6 inches of the stalk, and hung up in paper bags in a dry room. In the end of January or beginning of February it may be sown in pots or boxes of light rich mould, covered thinly with fine soil, and placed in a cold frame. In a few weeks the seedlings will make their appearance, and with the exception of keeping free of weeds and protecting from frost, they will require no further attention till the second year, when they should be planted out in a bed for blooming; this they will generally do in the fourth or fifth year from the time of sowing. When first produced the flowers present none of the beautiful variegations exhibited by established varieties, and the seedlings are called *selfs* or *breeders* till these markings appear, when the tulip is said to be *broken*. The period at which this takes place varies from one to fifteen years from the first flowering, and some breeders never break. In order to hasten the process various expedients are adopted, such as growing the bulbs in poor soil, exposing them to the weather between the time of taking up and replanting, and allowing seed to be produced, the effect of all of which is to diminish vigour and induce variegation. A change of soil and locality is also sometimes attended with good results.

Offsets are taken off when the bulbs are taken up after flowering, and should be planted in September in a bed by themselves, where they must remain till they flower, which they will do, according to their size, in from one to four years. They merely require protection from frost and routine culture. Afterwards they may be transferred to the blooming bed.

Situation and Preparation of the Bed.—The most eligible situation is a rather high part of the garden, freely exposed to the sun and air, but sheltered from strong winds. A low damp position is particularly to be avoided. A dry subsoil on a gravelly bottom should if possible be selected, but, if this cannot be secured, artificial drainage will generally be necessary. The position and size of the bed having been decided on, its formation should be proceeded with in September or early in

October. The natural soil must be excavated to the depth of 2 feet, and, if drainage is required, a drain 1 foot wide and the same in depth ought to be dug out along the middle and filled up with brickbats, which should then be covered with sods, or tiles may be laid; but in either case a proper fall and place of outlet must be secured, two essential points which are frequently forgotten. The soil employed for filling in may consist of four parts rich friable sandy or turfy loam, which has been laid in a heap for a year or more, one part of vegetable mould, and one of thoroughly decomposed manure, well mixed together some time previous to use. With this the excavation should be made up to the level of the surrounding paths; and to prevent the soil from falling down upon these after planting, as well as for the sake of appearance, an edging of boards, or still better of slate or stone, ought to be placed round the bed. It is unnecessary to form a fresh bed every year, for the tulip will remain healthy and produce fine flowers although grown in the same soil for several seasons; but it is advisable to ridge up the soil of the bed every year, in order to expose it to the action of the air and weather, adding also some fresh compost, and at the end of every second or third year to remove the old soil to the depth of 1 foot, and replace it with fresh, turning up at the same time the compost in the bottom.

Planting.—This operation should be performed in the end of October, or not later than the second week in November; and for some time previous the bed should be protected from heavy rains, for nothing is more injurious than to plant in soil saturated with moisture. The bed may either be raised 9 or 10 inches above the level of the surrounding ground, taking care to keep the centre about 2 inches higher than the sides, and the bulbs put in with a dibber, or the following system may be adopted. After raising the bed to about 6 inches above the paths, and raking the surface smooth, the bulbs are deposited at their proper places, some silver sand being placed beneath and around each, and then covered with compost to the depth of 3 or 4 inches, according to their strength. The distance between the bulbs may be 6 inches.

After-treatment.—After planting, the bed must be protected from heavy rains, and at the approach of winter hoops and mats or other covering should be placed over it to

prevent injury from severe frost; but except during heavy rain, this covering should be removed at every opportunity of mild weather. In spring the surface soil will require to be carefully stirred whenever it is likely to become too hard; and if gentle rains do not occur, and the plants are in danger of suffering from drought, slight waterings may be given, provided the weather is mild. As soon as the buds begin to show colour, an awning of thin canvas is placed over the bed so as to effectually exclude the sun's rays; at the same time a free circulation of air must be preserved by rolling up the canvas on the shady side. Injury from wind will also have to be carefully guarded against. As soon as the flowers begin to fade the awning may be removed, and the plants fully exposed. All the seed-pods should be cut or broken off at an early period of their growth. When the leaves turn brown, and the stalks bend round the finger without breaking, the bulbs may be taken up, choosing the morning or evening for the operation. After taking up they should be placed for a few days in a cool airy situation, where they will not be exposed to the sun, which would be certain destruction to them. When dry and firm, the offsets and loose dry skins may be removed, and the bulbs themselves stored away, either in drawers in a cabinet pierced with holes so as to afford a free circulation of air, or in bags of gauze or muslin. Whilst out of the ground they should be occasionally examined, and any that are in a decaying state must at once be removed.

The Duc Van Thol (*T. suaveolens*), and other early tulips which bloom in April and May, succeed well in any light rich border which has been deeply dug. When grown in this way they require no protection, and in other respects may be treated like the late kinds. By potting in autumn, and placing them in a green-house in December and January, they may be had in flower in February and March, and after flowering they should be removed to a cold frame.

THE HYACINTH (*Hyacinthus orientalis*, L.), a native of the Levant, has long been an inmate of our gardens, where it is esteemed one of our earliest and most beautiful spring flowers; and for producing a brilliant display in the greenhouse during the winter months, it is scarcely surpassed by any other bulbous plant.

It is propagated by seeds for obtaining new

varieties, but as these are mostly imported from the Continent, that mode of propagation is seldom practised in this country. The seed may be sown in September, in light sandy mould, and covered to the depth of about $\frac{1}{2}$ inch. During the winter, protection should be given from frost, and when the leaves die down, 1 inch of fine mould should be sifted over the plants, and in the following year they must be treated in the same way. In the third year the bulbs may be taken up when the leaves turn yellow, and afterwards they should be treated like old bulbs, only not covered so deeply. The seedlings flower in the fourth or two following years. The offsets are removed soon after the bulbs are taken up; they should be planted 2 inches deep, in a bed of light soil, deeply dug, where they will merely require to have their flower stems cut off for two years after planting, and to be treated in other respects like the old bulbs. They may be planted in the autumn of the third year in a bed for blooming. In order to cause an increased production of offsets, the Dutch, after taking up, make four cross cuts half-way up a healthy bulb, which is then dried like the others, planted apart, taken up in the following year, during which little or no foliage is produced, and the young bulbs separated, and dried on a board.

Culture in Beds.—Although the hyacinth will bloom well in any good garden soil of a light nature, yet, to flower it in perfection, and maintain the bulbs in a healthy condition, a bed should be specially prepared for its growth. The situation should be rather high, and well exposed to the sun; and if superfluous moisture does not readily pass away, the ground should be deeply and thoroughly drained. The soil ought to be dug out in August to the depth of at least 2 feet, and replaced with prepared compost. As to what is the most suitable, some diversity of opinion exists; the Dutch use soil of the lightest description—their own light sandy mould rendered still lighter by the addition of fine sand, and enriched with cow-dung; or decayed leaf-mould, river sand, and cow-dung are placed in alternate layers for six months, then chopped up together, again laid in a heap for some weeks, and finally put into the beds; but even then hyacinths are not planted in it the first year. In Britain, soil of a heavier description is usually employed, but there can be no doubt that sandy soil is the most suitable;

it is in such that the plant grows naturally, it is in such that the Dutch cultivate the fine varieties which they yearly export to all parts of Europe, and it is in such alone, we believe, that there is any prospect of preserving these for any considerable time in our climate, cold and sunless in spring and summer, as compared with that which the plant enjoys in its eastern home. We would therefore recommend a compost of two parts light friable turfy loam, or sandy loam and peat, and decayed leaf-mould, sand, and rotten cow-manure, one part of each, the whole well mixed, laid in a heap for some months previous to use, and occasionally turned. The bed having been filled with the prepared soil, so that, allowing for settling, it may be about 4 inches above the adjoining path, should be levelled in October, keeping the centre 2 inches higher than the sides for a bed of the ordinary width, 4 feet. Planting may then be proceeded with in the same way as for tulips, placing the bulbs 8 inches apart, and at a depth of from 3 to 7 inches, according to the size of the bulb, the nature of the variety, whether strong growing or the contrary, and the lightness of the soil. The largest bulbs, and the strongest growing varieties, should be planted deepest; but in heavy soils it is not advisable to cover so deeply as in those of a lighter description. As a general rule, 4 or 5 inches may be taken as good average depths in light soil. A little silver sand ought to be placed beneath each bulb, which, when placed in its position, should likewise be just covered with sand. After planting, no attention is required except protecting the bed from severe frost by a layer of tan, straw, or some protecting material; but this covering should be removed before the plants push in spring, when they may be protected by hoops and mats, but these must be taken off whenever the weather is favourable, otherwise more damage is likely to arise from the leaves and stems being drawn up, than from the frost. When in bloom, an awning of calico or thin canvas may be placed over the bed, to screen the flowers from sun during the heat of the day, but it should be taken off before evening; and after flowering this covering may be kept on during heavy rain; at all other times, however, the plants should be freely exposed to air and light. The flower stems should be broken off immediately after the bloom has faded, as the production of seed will tend to exhaust the bulbs. These must

be taken up when the foliage assumes a yellow colour, and the leaves having been cut off, spread out on a dry bottom in an airy place which is shaded from strong sun, to complete their maturity. During the process of drying, they ought to be occasionally turned, and any loose earth adhering to the roots shaken off, and all unsound bulbs picked out. When dry, the rough outside skin, fibres, and offsets, may be removed if they part readily from the bulbs, which may then be placed, without touching each other, in open drawers with perforated bottoms, in baskets, or on shelves, in a dry airy place, where they should be occasionally looked over, and any which exhibit symptoms of unsoundness carefully removed.

The Dutch pursue a different system in the management of the bulbs. When the tips of the leaves turn yellow they level a portion of the bed, place the bulbs on their sides close together, with their roots facing the south, and cover them with an inch or two of earth. At the end of two or three weeks they again take up the bulbs, expose them to the air for some hours, clean them, and place them on shelves to dry. It may however be observed that this method is not practised on moist heavy soils.

In replanting, the Dutch never place the bulbs in beds where hyacinths have been grown in the preceding year; they always allow an interval of at least two years, and more frequently three, before they plant again in the same bed, the soil of which is enriched by the addition of rotten cow-dung in the winter previous to planting.

Culture in Pots.—For flowering the hyacinth in pots in the greenhouse during the winter, a mixture of two parts loam, and peat, decayed leaf-mould, well decomposed cow-dung, and river sand, one part of each, makes perhaps the best compost that can be employed. When the plants are required to bloom as early as Christmas, they should be potted in 6-inch pots in the end of August or beginning of September, and for succession, from that time to the end of October. The pots having been well drained, and filled nearly to the top with soil, a little sand should be placed in the centre, and upon this the bulb must be placed; it should then be surrounded with soil, but so as to leave about half of the bulb above ground. The pots should then be placed on a dry hard bottom out of doors, and covered with 6 or 8

inches of decayed tan, leaf-mould, or sand, leaving them thus for about six or eight weeks, by which time, or sooner, the pots will be well filled with roots. As soon as this is the case, the most forward may be removed to a frame, where they should be gradually exposed to the light; and when the foliage has become green, they may be placed in a pit where a temperature of from 60° to 70° is maintained. Attention must be paid to watering, and an occasional application of weak liquid manure may be given as the truss advances. When the flowers begin to expand, the temperature may be gradually lowered; and when in full bloom the plants should be placed in the greenhouse. Throughout their growth they should be fully exposed to the light, and as much air as is consistent with maintaining the temperature required. By bringing in the pots according to the time of potting, and as they successively get filled with roots, and by placing in heat, or merely in the greenhouse, a succession of bloom may be obtained throughout the winter. After flowering, the pots should be placed out of doors till the leaves decay; the bulbs may then be taken up and kept in a dry place till autumn, when they may be planted in the borders; it would, however, be more in accordance with nature if the pots were placed near the glass in a pit or frame, where the bulbs could ripen under an increasing temperature, and without the check which must be the result of their transference from the greenhouse to the open air.

In Glasses.—Hyacinths grown in glasses are very ornamental in drawing-rooms, and their treatment is exceedingly simple. Firm, well ripened bulbs should be chosen, and the glasses having been filled with rain-water, the bulbs should be placed so that their base may not touch the water by at least half an inch. The glasses should then be placed in a warm dark place, and when the roots are about 4 inches in length, removed to the light, but the bulbs ought not to be fully exposed too suddenly; afterwards they should have all the air and light possible, otherwise the foliage and flower-stem will be drawn up and weakly. When the leaves are produced, the glasses may be filled up with water nearly to the base of the bulb. Fresh water should be supplied whenever that in the glasses becomes impure, but, at whatever time it is given, it ought to be of the same temperature as the air in which the plants are growing. After

flowering, the bulbs are generally thrown away, but they will recover if planted out of doors in suitable soil.

CHAPTER XXIII.

THE GREENHOUSE AND CONSERVATORY.

By a greenhouse was formerly understood a structure barely suitable for the protection of certain exotic evergreen shrubs in winter, such as oranges, myrtles, &c. The importance of light to vegetation was imperfectly understood, and high windows in front of the building were thought sufficient, whilst a roof impervious to light was reckoned the best, on account of its being warmer than a glazed one. But a greenhouse is now expected to contain a succession of plants in flower throughout the year; and to maintain such in health, a greater abundance of light is necessary than was required in merely protecting evergreens. Therefore, greenhouses should be so constructed as to obstruct the rays of light as little as possible. Light should be the first consideration; and here it may be observed that a greenhouse cannot be maintained in a state that would be accounted sufficiently gay without the assistance of pits, in which plants can be grown still nearer the light than in the greenhouse, except on the stages near the glass, or in a house of small dimensions.

Air.—A free circulation of air is essential to the health of most greenhouse plants, and, therefore, the means of giving air to an ample extent should be at command, otherwise, the structure being light, the sun's rays would frequently raise the temperature too high for greenhouse plants, and it is better to keep down the temperature by a free circulation of air, than to exclude the sun's rays by shading. It is admitted that ventilation through numerous small apertures is better for the plants than the same quantity of air through a few small openings; therefore the laps of the glass should be small and well fitted, but not puttied, so that an interchange of fresh air may go on night and day, through the interstices of the laps.

Air should be very freely admitted to greenhouse plants when the state of the weather will permit. When the external air is below 40° ventilation is not necessary, unless to dis-

pel damp; at 50° it should be tolerably free, and 60° liberal. The extent of ventilating space allowed for every 10° of rise in temperature should not be equal; the space allowed for the rise from 50° to 60° should be in much larger proportion than that allowed for the rise from 40° to 50°; and again, the rise from 60° to 70° should have an additional extent of opening, much greater than that allowed for the preceding rise of 10°. Indeed, at 70° all the air possible ought to be given. Before the plants are turned out, air, of course more or less according to the state of the weather, should be admitted at night, in order to harden the plants, so as to render them less liable to be affected, when placed out of doors, by the cold nights, which occur even in our summers.

Temperature.—A considerable number of greenhouse plants, chiefly of a hard-wooded description, will not be injured by a temperature occasionally as low as 32°; some New Holland plants will even bear several degrees below freezing; but many soft-wooded species cannot safely withstand so low a temperature, even although they may not require one higher on the average than those which will bear a lower extreme. We may rest assured that no greenhouse plant is benefited by a temperature below freezing; and, on the other hand, that many kinds would be injured by that degree of cold. This being the case, we conclude that 35° is the lowest degree to which greenhouse plants ought to be exposed; and in general 38° or 40° as the minimum is to be preferred. Within a range of between 40° minimum and 55° maximum, no greenhouse plant will become over-excited, and, at the same time, the vigour of many species liable to be weakened in constitution by a lower temperature will be maintained.

Watering.—When plants are growing freely they of course evaporate more than when they are in a state of comparative rest. In the former case there is little danger in giving a liberal supply of water; in the latter, great caution is necessary, otherwise the soil in the pots will get water-logged, and the roots will consequently be in danger of perishing. On tapping against the outside of the pot, when the earth within is saturated, the sound is like that from a solid body, but when the earth is not saturated, the sound is more hollow, from the interstices of the soil being filled with air instead of water. The difference will best be understood by tapping against the side of

the pot immediately after watering, and against the same when water is required. In the winter the plants should be kept rather dry than otherwise; and no water should be given unless the soil in the pots is seen to be dry. In continued moist and sunless weather, the interior of the house will become too damp, and the excess of moisture will, in that case, have to be driven off by a little fire-heat. For this purpose the fire had best be lighted in the morning of a day when the external temperature will permit of free ventilation being afforded. In warm weather, on the contrary, the air of the house is apt to become too dry; this can be remedied to a considerable extent by keeping the paths moist, and by syringing in the morning, and in the afternoon before the ventilation is finally reduced for the night.

Soils.—The principal soils required for greenhouse plants are loam and peat; and for mixing with these sand will also require to be provided. Some well decomposed dung and leaf-mould, and for succulent plants lime-rubbish, will likewise prove useful. The above, simply, or by admixture, afford a variety of soils, designated as follows:—Loam, turfy-loam, light turfy-loam, sandy-loam, peat, loam and peat, sandy peat, sandy-loam and peat, sand and turfy-peat; and in one or other of these the generality of plants will thrive. Turfy-loam will suit a great many plants; if it can be obtained of a quality rich enough by itself to produce a vigorous growth, there is no necessity to add other ingredients. A soil that is naturally good, is better than an artificial one, and in such the growth is more uniform and healthy. A number of ingredients may answer well for a time, but afterwards the nature of some of them is more apt to change, both mechanically and chemically, than that of naturally good soil. If turfy-loam require to be made lighter for some delicate rooted plants, that can be done by admixture of silver sand, leaf-mould, or peat. The loam should be chopped more or less fine, according to the strength of the plants, but it should not be sifted. Many plants with small fibrous roots, as the Heath, Azalea, Rhododendron, Epacris, require a peat soil, free from lime, which is found to be injurious to them.

Propagation.—This is effected by cuttings and layers, and in the case of many species, by budding and grafting. Seeds of some kinds of plants are matured in this country, and a

portion may be sown immediately after gathering, unless it is known that they will keep till early in spring, for this is the best season for raising seeds on account of the young plants getting the benefit of increasing light and heat. A portion of seeds received from abroad should be sown as soon as received, in case they might not keep till the most desirable period for sowing. Spring is also the best time for striking cuttings of all such sorts as have wood fit for the purpose at that season; but propagation by this mode should be attended to when the shoots are in the most favourable condition for striking root, for in some plants the young and tender shoots succeed the best, in others the mature and ripened; and in many more, those which are half ripe, or which have acquired some considerable degree of firmness, are the most proper. Cuttings of the roots of some plants afford a ready means of propagation; and grafting, budding, and inarching are applicable to the Orange tribe, Camellia, &c.

Placing Out of Doors.—It is usual to turn out greenhouse plants in summer, or, at all events, a considerable portion of them. The time for doing so depends on the season and nature of the climate. Some of the less tender species may, in the warm southern parts of the kingdom, be turned out about the middle of May if the weather is fine; but generally this month is not to be trusted, and early or late in June, according to the season, is a more appropriate period for placing the generality of greenhouse plants out of doors. The situation should be warm, and well sheltered from the north, and, we should say, fully exposed to the south, were it not for the difficulty of keeping the plants sufficiently watered, for foliage exposed to the sun's rays of course evaporates more than that which is in the shade; besides the action of sun-heat on the sides of the pots is very injurious, for the roots in contact with them are subjected to great and frequently sudden changes of temperature, and occasionally to excessive dryness. These effects of the sun's rays might, however, be guarded against by filling in the intervals between the pots with leaves or moss, or by plunging the pots in sand, or sandy soil; and if they were set on a small pot plunged with its mouth upwards, drainage would be insured. In some cases the pots containing the plants may be put in a pot a size larger, moss being placed between the two, or pots cast double

might be employed for some particular plants, where expense is no object. The advantage presented by these arrangements is a greater uniformity of temperature and moisture at the roots than would exist if the pots were exposed. Where circumstances do not admit of these modes being adopted, the plants should be set on a floor of sifted coal ashes laid with a gentle slope, and made firm by rolling, in a situation which is shaded from the sun's rays during the hottest period of the day, but exposed to them in the morning and afternoon. Previous to setting out, the plants should have full air, night and day, in order that the change to out of doors may be less felt; and after they are put out, it would be well if they were protected by some sort of awning in cold nights. In the beginning of September the more tender plants should be taken into the house, which, in case of bad weather, should be got ready for receiving the remainder.

Pruning.—This is necessary, in order that the plants may exhibit a regular form of growth; if neglected many kinds would consist of an irregular assemblage of strong and weak shoots, crowded where few or none are required, and entirely wanting where branches are most desired. On referring to the chapter on pruning, the mode of operating for inducing buds to push where wanted will be found, as well as the principles according to which the flow of sap can be diverted from parts that are too strong to those that are too weak. If these principles are acted upon no great irregularity of growth will take place, and consequently no great reformation by the pruning knife will at any time be required, except in cases where a general cutting back becomes necessary. It shows great want of skill to allow shoots to grow in summer for no other purpose, evidently, than to be cut away in winter; all such ought to be checked in the first instance. By pinching or topping, shoots can in general be abundantly produced, and by attention to training, plants may be made to assume a symmetrical form. For example, a plant may be seen furnished with branches all round near its base, and again at top—this is a proof that the plant is capable of producing lateral shoots on all sides; but it may happen that its middle portion is only furnished with shoots on one side, and this is equally good proof that it has been neglected in training. If it is a plant that

requires the central leader to be preserved, it should have been bent so as to induce laterals to break towards the naked side, but if not, the leader should have been stopped in time, and laterals to furnish all sides would have resulted. In general, plants that require to be cut back should have this operation performed as soon as they have done flowering. Various other matters of a routine nature will be found in the Calendar of Operations.

We will now proceed to treat briefly of a few of the principal plants cultivated in the greenhouse and conservatory, or in the pits and frames, where a temperature approximating that of a greenhouse is maintained, and to give lists of the most ornamental plants which may be grown in these structures.

Plants employed for furnishing the greenhouse and conservatory are chiefly of a shrubby nature; intermixed with such, annual or herbaceous kinds do not assort well, but they may nevertheless be appropriately introduced on front shelves, in order to maintain the house in a gay instead of a desolate condition, during the time that many of the greenhouse plants are out of doors in summer.

Bulbous plants grown in pits and brought into the house when in bloom, are likewise of great value for filling the shelves with flowering plants, when there is little else to produce a display.

Climbers are required for ornamenting the rafters, especially when these are of wood; some of them, as for example, *Mandevilla*, *Hardenbergias*, *Kennedias*, &c., are adapted for large houses, whilst for those of smaller size, *Jasminum gracile*, and *Lapageria rosea* (Plate V.), are peculiarly well adapted; indeed, from no conservatory, large or small, should this beautiful plant be absent.

CAMELLIA (*Monadelphica Polyandria*, L.; *Camellieæ*, D. C.; *Ternstroemiaceæ*, Lind).—The Camellia is an evergreen tree or large shrub, a native of Japan, and introduced into this country before 1739. The beauty of its evergreen foliage and its magnificent flowers, abundantly produced in spring, and even in the middle of winter, render it a permanent favourite. Like most Japan plants, it withstands our winters out of doors; but its flower-buds are tender, and therefore it is generally treated as a greenhouse plant. In its native country it is exposed to severe winters and hot summers. As there has been considerable misconception with regard to the hardness of



Drawn by M. W. He

Eng. and by Geo. Cook

C. J. W. ELLIOTT.

1 *Augustina superba*. 2 *Caryophyllodes*

the Camellia, we may state, on the authority of Humboldt, that at Nagasaki, lat. $32^{\circ} 45'$ N., where it grows abundantly, the mean temperature of winter is $39^{\circ} 38'$; of spring, $57^{\circ} 56'$; of summer, $82^{\circ} 94'$; and of autumn, $64^{\circ} 22'$;—that of the warmest month, $86^{\circ} 90'$, and of the coldest, $37^{\circ} 40'$. It thus appears, that in the native country of the Camellia, the summer temperature is quite equal to that of the hottest tropical countries; but the three winter months are just as cold as they are in the neighbourhood of London; and we know that there Camellias planted in common garden soil at the back of a north wall have grown to be large bushes, although at all times unprotected, and exposed on several occasions to the temperature of zero of Fahrenheit, and even then the plants were uninjured. This completely settles the question of its hardiness.

Of the varieties, which are very numerous, the following are some of the best; but many others might be added which are quite as good:—

- Alba plena, the old double white, very fine.
- Albertus, blush, striped with carmine.
- Archduchess Augusta, crimson, veined with purple, and tipped with white.
- Augustina superba (Plate VI.), delicate rose, very fine.
- Aulica, blush, much striped with flesh.
- Bealii, crimson, late.
- Candidissima, large, pure white.
- Caryophylloides (Low—Plate VI.), blush, striped with carmine.
- Chandleri elegans, pink, sometimes mottled with white; very large.
- Countess of Ellesmere, cream, striped with flesh.
- Countess of Orkney, white, striped with carmine.
- Cup of Beauty, white, with faint pink streaks.
- De la Reine, white, striped with rose.
- Donkelaarii, semi-double, red, striped and blotched with white.
- Duc de Bretagne, bright rose.
- Duchesse d'Orleans, white, blotched and striped with carmine.
- Fimbriata alba, white, petals fringed.
- Henri Favre, bright rose.
- Imbricata rubra, carmine.
- Incarната, blush white.
- Jubilee, cream white, striped with rose.
- Lowii, deep carmine, sometimes striped with white.
- Marchioness of Exeter, bright rose, very large.
- Marguerite Gouillon, white, striped with rosy carmine.
- Mathotiana, dark crimson.
- Miniata (Low), bright pink.
- Montironi, white, veined with rose.
- Princess Bacchiochi, carmine, striped with white.
- Princess Frederick William, white, striped and mottled with rose.
- Reine des Fleurs, carmine.
- Reticulata (species), semi double, bright rose, with yellow stamens; very large.

Storyi, pink.

- Targioni, white, striped with crimson
- Teutonia, white, rose, or white striped with rose.
- Traversii, rosy crimson, striped with white.
- Tricolor, semi-double, white, striped with crimson.
- Valteveredo, bright rose.

Propagation.—This is effected by seeds, cuttings, layers, grafting, budding, and inarching. The seeds should be sown early in spring in sandy loam, placed in a gentle bottom-heat, and kept shaded till they vegetate, when they should be exposed to a subdued light, and not to the direct rays of the sun. When the plants have formed two or three leaves, they should be potted in sandy loam and peat, in 3-inch pots.

Propagation by cuttings is now much employed, and more especially for producing stocks, for which purpose the single red answers well. Cuttings may be struck at any time of the year, but most readily when taken off before the shoots have completed their growth, but are ripe at the bases, in July or August. Some make them 4 or 5 inches long, removing the lower, but leaving the two upper leaves; others succeed very well with a short cutting, with only a leaf and a bud. The cuttings should be inserted in pots filled with a mixture of loam, peat, and sand, with about $\frac{1}{2}$ inch of silver sand at top, and plunged in gentle bottom-heat a few degrees warmer than the average top-heat in which the plants were growing previous to the cutting having been taken off. They will root in six weeks, and may then be planted singly in 3-inch pots; after potting they must be kept shaded till they have taken fresh root. Some of the nurserymen near London put in the cuttings in September, and place the pots in a cold frame for three months; then they remove them to a propagating house, where they are kept growing till the end of June, when they are potted off singly into 3-inch pots, kept close and shaded for a few weeks, and grafted in September.

To obtain shoots for layering, plants for stools should be planted in a pit, and cut back to induce them to produce shoots near the ground; these should be layered in autumn, detached and potted in the following autumn, and they may be grafted in the succeeding spring. This is the usual mode; but the French layer the young growing shoots before the wood becomes firm, in which state they root so much more readily, that they may be separated from the parent stool, and potted in the same season.

Any of the various modes of grafting may be employed; but that of whip-grafting is by far the best, for it insures the neatest and soundest junction. The best time for performing the operation is in spring, just before the plants begin to push afresh; but it may be done at any time when ripe cuttings can be obtained, even in the middle of winter; for if placed in bottom-heat and covered with a hand-glass in a propagating-house, the graft will take readily. Budding should be performed when the vegetation of the plant is active. When budded the plants should be kept close, and when the bud has taken, the top of the stock ought to be reduced.

By inarching, a plant able to bear flowers is soonest obtained; but the junction of stock and scion is not so neat as that resulting from grafting. February and March are the months to be preferred for performing this operation; but it may be done at any time from November till March. Plants inarched early in spring may be separated from the stool in the beginning of November, or earlier if heat be applied.

Soil.—The Camellia will grow in almost any good rich soil, provided its mechanical texture is such as to admit of the free circulation of water; in other words, it should not be so adhesive as to become compact. To prevent this, the turf should be chopped to small pieces, and well mixed with enough sand to keep it open, even when the fibre of the turf is decomposed. In France, peat alone is mostly used; in Belgium, well decomposed leaf-mould; and in this country, loam is the principal component. Two parts friable turfy loam, one of peat, and one of leaf-mould, or well decomposed dung, with a portion of sand to keep the whole in an open state, answers well. Some use equal portions of peat and loam; others three of peat and one of sandy loam. There are, it may be remarked, some rich turfy loams in which most plants thrive well until the fibres get decomposed, and then with watering they become too adhesive.

Shifting.—This with care may be done at any time, but immediately after flowering is the most proper. If performed during the period of flowering, the blooms would be liable to experience a check; but after flowering, the sooner the plants requiring it are shifted the better, in order that the growth of the young shoots which then begin to push may not be interrupted. If shifting is not performed at

this period, it will be advisable to wait till the summer's growth is completed, which may be in August, sooner or later according to circumstances. The drainage should be plentiful, and may in part consist of pieces of charcoal. For large plants some half-inch bones may be employed, as they will serve both for drainage and nourishment. In shifting, care should be taken that the roots are so spread out as not to wind completely round the ball, for when this is the case, bad consequences ensue as the roots enlarge.

Temperature.—The Camellia starts into fresh growth after flowering, as already observed, and on the young shoots, towards their maturity, the flower-buds are formed. These in their native country experience a winter's cold, and expand early in spring, whilst the temperature is still rather low, and in forcing this should be borne in mind. A considerable period of comparative rest elapses from the formation of the flower-bud in summer until its development in the following spring; therefore when Camellias are required to be brought early into flower, the maturity of the shoots ought to be accelerated so as to allow time for a gradual formation of the blossom-buds. When making its shoots, the Camellia will bear a temperature of from 65° to 80°; when the shoots are hardened, the extremes may be gradually reduced to 60° minimum, and 75° maximum, and still further to 48° minimum and 62° maximum, or to a mean of 55°. We think it safe not to let the temperature fall at any time below 35°, and generally not lower than 40°. Although the plant in its natural climate will bear a degree of cold many degrees below freezing, yet under glass, and in our variable winters, the blossom-buds will occasionally be subjected to a temporary excitement, after which they will become more susceptible of cold than if they had been exposed to a uniformly low temperature. The minimum temperature should not be regulated to any particular degree, but according to the amount of excitement from heat to which the plant has been subjected. If this has been such as to put the sap in active motion so as to sensibly affect the swelling of the flower-buds, that activity must not be checked, otherwise the flowers will not be produced in perfection. A temperature as low as, or lower than, the freezing point, will do no harm if little excitement has taken place previously; but the same would prove highly injurious in

cases where a comparatively brisk flow of sap has been induced.

Watering.—The quantity of water necessary to be supplied depends on the temperature and dryness of the air, and the condition of the plant as regards its more or less active state of vegetation. The supply of moisture should be liberal during the period of growth, increasing with the heat of the season till July, and then, in order to ripen the wood and flower-buds, it should be gradually diminished. If the plant is growing vigorously, with a high temperature and in a dry air, a large amount of water at the root will be necessary, with frequent syringing of the foliage and watering the paths in order to produce a moister atmosphere. But when the plants are in a nearly dormant state, very little water will be required. If it is found that the soil about the roots continues long after watering in a saturated condition, the plant should be taken out of the pot, divested of all unsound roots, and repotted in a more porous soil. When growing too vigorously and to wood, instead of forming flower-buds, the plants should be kept rather dry, but at the same time great care must be taken that they do not suffer the least from dryness. The foliage, it is scarcely necessary to observe, should be kept clean by syringing, and at times by sponging. Manure water may be given when the buds are swelling, and also when the young shoots appear to be making but weakly growth. Care should be taken that the water employed either for the roots or foliage be not colder than the medium in which the plants are growing.

Situation.—A span-roofed house running north and south answers best for Camellias, except when they are placed rather far from the light, as against the back wall of a range, and in that case a direct south aspect is to be preferred. In warm situations and hot summers, they may be placed out of doors in a half shaded situation; the month of July is soon enough to put them out, and they should be taken in early in September, but then plenty of air should be admitted. In winter little heat, air, or moisture is required, except as regards plants intended to be forced. In France, the cultivation of Camellias is well understood and extensively practised; there, in long span-roofed houses covered with leaves to keep out the frost, Camellias exist for months during winter and early spring, so

that little trouble or expense is required during that period; their flowering is retarded, but when uncovered the plants exhibit a healthy appearance. From this it appears that in winter they thrive in the absence of light better than most plants; but in their season of growth, partial exposure to sunshine is beneficial.

Pruning should be attended to, with the view of maintaining regularity among the branches, and insuring as far as possible an equal distribution of the sap. Therefore, when one or more shoots are appropriating an undue share of the sap, they should be checked in good time. Occasionally the heads are cut back; this should be done in spring, and if the pots are immediately placed in a moderate top and bottom heat of between 65° and 75°, fresh shoots will soon be produced, the growth of which should be regulated so as to form a handsome well-balanced top.

Forcing.—The Camellia will not bear to be rapidly forced, as in that case the blooms are apt to drop. In order to have plants in flower early in winter, preparation should be made in the previous spring. The varieties which are first out of flower should be immediately put into a gentle heat, which must be gradually increased so as to get the young shoots grown to a moderate length early in the summer, and the temperature ought then to be gradually lowered. The decrease in temperature will have the effect of preventing the further elongation of the shoots, but the flower-buds will continue to swell. Care must, however, be taken that the process of swelling goes on gradually and without check, till finally the flowers expand.

CAPE HEATHS (*Erica*, L.)—By their general aspect heaths are easily recognized, although the species and varieties comprised in this tribe exceed 500 in number. Their leaves, small, narrow, rigid, and evergreen, are thickly set on shoots which, possessing considerable elasticity, wave gracefully with the breeze. On the whole, heaths constitute an elegant tribe of plants, worthy of the especial care which is necessary for their successful culture. Although so much of a general aspect is exhibited by the genus, yet there exists in the size, form, and colour of the flowers, a considerable diversity in the different varieties, of which the following is a list of the best:—

Aitoniana turgida, *Albertii superba*, *ampullacea major*, *ampullacea rubra*, *aristata major*, *Bandonii*, *Bowiciana*,

Cavendishii, Clowesiana, delecta, Devoniana, Eassonii, elegans, fasciculata superba, fastigiata, ferruginea, gemmifera major, glauca, Hartuelli virens, hyemalis, inflata alba, inflata rubra, intermedia, Jacksonii, jasmiflora alba, Juliana, Lambertiana, Lambertiana rosea, Lawrenceana, mammosa rubra, M'Nabiana, M'Nabiana rosea, Massonii, metulæflora, metulæflora bicolor, mundula, mutabilis, Neillii, obbata (Pamplin's), obbata umbellata, odorata, Parmentieri rosca, perspicua nana, physodes, princeps carnea, propendens tubiflora, pulcherrima, retorta major, Rollissonii, rubella, Savilleana, Shannoniana, Spenceriana, splendens, Sprengelii, suaveolens, Swainsonii inflata, taxifolia, Templea, togata, tortulæflora, tricolor Dunbarii, tricolor major, tricolor Wilsonii, trosula, vasæflora, ventricosa alba, ventricosa Bothwelliana, ventricosa grandiflora, ventricosa hirsuta, Vernonii, vernix coccinea, vestita alba, vestita coccinea, vestita rosca, Wilmoreana.

Propagation.—This is effected by seeds and cuttings. Spring is the best time for sowing the seeds, for if raised in autumn or winter the seedlings are apt to damp off. Let some pans or shallow pots be well drained with broken pots; over these place a layer of turfy peat, then fill up to within half an inch of the top with sandy peat, which should be slightly and evenly pressed; sow the seeds on this; cover very thinly with sifted peat, and let the whole be moistened through a very fine rose. The seed-pans should be kept in a rather warm temperature, and shaded from the direct rays of the sun. When the young plants make their appearance, they must be gradually exposed to more light and air; and as soon as they acquire sufficient firmness they should be potted off singly into small 60-sized pots, placed in a close frame, and kept shaded till they strike fresh root, when they must again be gradually exposed to light and air.

In propagating by cuttings, it is desirable that they should be struck as early in the season as possible, in order that they may become well established plants before winter. The soft wooded kinds may be propagated in spring, or at any time; but the hard wooded sorts must be struck in August, when the wood is fit. Healthy vigorous shoots ought to be selected, and these having been taken off when their wood is a little firm at the base, the leaves on the lower half should be removed. Fill the cutting pots about two-thirds with broken pots; above this place a thin layer of turfy peat, finishing with silver sand. In this insert the cuttings from $\frac{1}{4}$ to $\frac{1}{2}$ an inch deep; then water, and place under a bell-glass in a temperature of from 60° to 65°.

Soil.—A sandy peat is the best soil for heaths; it should be taken from a place where heath

is observed to make a healthy vigorous growth. The sand it contains may be rather coarse, but it should be white, for a red or yellow colour is indicative of the presence of iron. According to some analyses, it appears that soda enters in large proportion into the composition of the heath; we may therefore conclude that soil on which heath has grown and has been frequently burned down would prove suitable. If the peat is found to be too adhesive, a liberal addition of silver sand should be intimately mixed with it. For the lower part of the pot some small rounded brook pebbles, or pieces of broken freestone answer well for retaining a certain amount of moisture, and, at the same time, afford excellent drainage for water that would remain stagnant, or produce saturation. For the upper part of the pot, the peat should be finer, but still of a nature that will permit of the free percolation of water among its particles.

Culture.—A span-roofed house, running north and south answers well for heaths; for by this arrangement the force of the sun's rays at noon, and for hours before and after, is diminished, in consequence of falling obliquely instead of perpendicularly, or nearly so, on the glass. Besides, the roots are liable to be injured when the pots are exposed to the south; but when placed in rows, in the direction of north and south, each plant shades the pot behind it. In a house of this description, with a command of heat from hot-water pipes, in case of severe weather, Mr. Glendinning grows Cape heaths remarkably well, and, even when out of flower, their elegant forms, and healthy green foliage, constitute a sight which, in order to appreciate fully, the lovers of this class of plants should see.

Temperature.—Heaths do not, by any means, require a high temperature; at the Cape of Good Hope the average temperature of the hottest two months is 67°, only about 4° higher than that of July near London, whilst that of the coldest three months, 54°, nearly corresponds with that of the middle of our May. From this it appears that, for a considerable part of the year, a cool temperature is natural to them, and experience proves that much fire-heat is injurious. It is desirable that frost should be excluded; but if this can be done by means of a warm covering it is preferable to using fire-heat for that purpose. If frost should at any time penetrate into the house, great caution must be exercised in raising the temperature. It should not be raised by fire-heat any higher than

the freezing point, and if a natural rise of temperature take place, the plants should be kept in the dark till such time as the air of the house is several degrees above freezing.

Air.—A free circulation of air is most essential to the heath tribe; without this the plants are apt to die off. As already observed, fire-heat should be employed as little as possible, consequently the temperature, during a great part of the year, must necessarily average rather low. This being the case, occasional high temperature is injurious, for such would render the plants susceptible to the comparatively low one, which a change in the weather might soon afterwards produce. Hence air, a free circulation of which is at all times necessary, should be still more abundantly admitted when the temperature would otherwise rise too high. During summer, and indeed at all times when the weather will permit, ventilation should also be afforded at night.

Water.—This should be of a soft nature, or as free as possible from mineral substances. Rain water is to be preferred. When the temperature of the house is low, with generally no dryness in the air, very little water will be required; when, on the contrary, the temperature is comparatively high, and the plants in a vigorous state of growth, a liberal supply of moisture must be afforded. Care should be taken that the ball of soil do not get dry in the centre, for, in that case, it is often difficult to moisten. When in an active growing state the plants should be syringed over-head every morning; and even in winter the opportunity of any dry day should be taken for clearing the foliage by syringing, after which the house should not be shut up till the foliage is dry. In close damp weather mildew is apt to make its appearance, and to prevent this flowers of sulphur should be dispersed in the atmosphere of the house, as well as over the soil in the pots, by means of a sulphurator. After dull moist weather, means should be taken to expel damp. As soon as there is some dryness in the external air, a little fire-heat should be given, together with an extra amount of ventilation.

Shifting.—This should be done at any period if the plants are not thriving; but, in general, the most proper time is just before they start into fresh growth, which is earlier or later in the season according to the sort. Acting on this principle, the operation of shifting will take place chiefly in spring; but it may be continued throughout the summer. The soil

for large plants should not be made so fine as for small ones, yet there ought to be enough of fine to fill up the interstices between the coarser pieces. Whilst a shift into the next size is practised by some, and into a much larger one by others, that of two sizes is, we think, a good medium. In potting, care should be taken that the upper part of the ball, or neck of the plant, is always higher than the surrounding soil, but at the same time not higher than the rim of the pot. The soil being of a light nature should be rather firmly pressed, and after repotting, the plants ought to be kept shaded and rather close for a few days.

Training.—When the plants are young any shoot that is likely to grow too strong for the others, should be stopped in time by pinching off its point, and this should likewise be performed when laterals are required to be produced. Some kinds of heaths naturally assume a pyramidal form of growth, and others have a spreading or a convex habit. In a collection the intermixture of these forms gives variety, and has a pleasing effect, and in training such kinds, the natural habit of growth should be encouraged.

PELARGONIUM.—The splendid varieties of this highly popular flower have been obtained from numerous species, natives of the Cape of Good Hope, by hybridizing, and afterwards crossing the variations which had thus arisen. The original species have now almost entirely disappeared from cultivation, only a few, such as *P. tricolor*, *odoratissimum*, *quercifolium*, *capitatum*, *peltatum*, *triste*, *quinquevulnerum*, *zonale*, and some others, being still found in the generality of gardens.

Propagation is effected by seeds, cuttings, and, in the case of the tuberous-rooted kinds, by division of the roots. The seed is best sown immediately after ripening, in pans of light soil, placed in slight bottom heat. It should be barely covered with fine soil, and, if likely at any time to become too dry, it must be moistened through a fine rose, or sprinkled. When the seedlings have made four leaves they may be potted singly in small pots, using light rich soil, and shaded for a few days till again established. Afterwards they should be placed near the glass, in a pit or greenhouse, where they will require the same treatment as to air and moisture as established plants, and be shifted as may be necessary, till in 5 or 6-inch pots for blooming.

Cuttings may be struck at any time in a

slight bottom-heat, or, in the summer months, if inserted in a warm-border, and covered with hand-glasses or a frame; but the most favourable period for propagation, when fine specimens are desired, is in June and July. Strong short-jointed shoots are to be preferred, and these having been cut close below a joint, and at 3 inches in length, should be inserted in a border as above recommended, or in pots well drained, and filled with a mixture of loam, leaf-mould, and silver sand—indeed, any good tolerably light soil will do. Cuttings of the fancy kinds may be struck in the same kind of soil, only some more silver sand ought to be added, and if a little of this substance is placed at the base of the cutting and slightly moistened it will be all the better, and tend to prevent damping off, which this class of *Pelargoniums* is apt to do. The assistance of a slight bottom-heat should likewise be afforded in the case of these varieties.

In propagating by division of the roots it is merely necessary to cut them in pieces 1 inch in length, pot, and place in a gentle bottom-heat, and as soon as shoots are produced, to inure gradually to the air.

Soil.—The *Pelargonium* in the early stages of its growth succeeds well in a mixture of fibrous loam and leaf-mould, with sufficient sand to keep the whole open; but after the second potting, a compost of a richer description should be employed. This may consist of fibrous loam, and well decomposed cow-dung, which have been mixed together, laid in a heap for at least six months, and occasionally turned, adding, previous to use, enough silver sand to keep the soil porous. Mr. Cock, who for many years exhibited the finest plants at the metropolitan flower shows, prepares his soil in the following manner:—He chops up some turfy-loam, and lays it in a heap, he then shakes up a quantity of stable litter by itself, soaks it with strong manure water, and covers it with slates to prevent the escape of ammonia. At the end of a fortnight, or three weeks, he adds to every barrowful of loam one of the dung, and throws the whole into a heap, which is covered with loam to prevent the escape of the ammoniacal gases. At the expiration of a month or five weeks, the compost is turned and mixed together; and this operation is repeated two or three times, in order that the whole may be thoroughly incorporated. At the end of a year the soil is fit for use, when a barrow-load of leaf-mould, and a peck and a

half of silver sand is mixed with the soil previous to potting. The late Mr. Catleugh, another eminent cultivator of the *Pelargonium*, employed a compost of two barrowfuls of good maiden loam, and one of well rotted cow-dung, three years old, laid in a heap, exposed to the weather, and frequently turned. To this he added, previous to potting, a peck of silver sand, except at the winter potting, when a somewhat greater proportion of sand was afforded, as well as a peck of bone-dust.

After Culture.—As soon as the summer struck cuttings are rooted, they should be potted in 3-inch pots, and placed in a cold frame where they can be shaded from the sun, or in a shady situation out of doors, the pots being placed on boards, or other hard material, in order to prevent the worms and other insects from penetrating into the interior. When the plants are established in the pots, which will be the case in about three weeks, they may be placed in a situation where the sun and air may have free access to them. They should then be stopped at the third or fourth joint, and in September repotted in 5-inch pots, and placed in a greenhouse or pit, where they ought to be kept rather close till again established. Afterwards air should be freely admitted whenever the weather is at all favourable, to the extent of leaving the front sashes open at night, when the external temperature is mild, and the wind low. In December or January, the strongest plants which have filled the pots with roots should be shifted into 8 or 9-inch pots, using plenty of drainage; the others may be shifted in February or March. During the winter months a temperature of 40° or 42° should be maintained at night; as much ventilation ought to be afforded as possible; the plants must be kept well exposed to the light on all sides; and no more water should be supplied than is necessary. In February or March the plants may be gently syringed overhead at 3 o'clock in the afternoon, when the house is shut up, so as to allow the leaves to get dry by night; and air should be given early in the morning to dispel damp. As the plants advance towards blooming, water should be liberally supplied, and air freely admitted; weak liquid manure may also be given with advantage two or three times a week.

When the flowers begin to expand, a shading of calico, or thin canvas, should be extended over the glass during the continuance of bright sunshine.

After flowering, the plants should be placed in a warm situation out of doors, where they can be sheltered from heavy rain, to ripen their wood, and in July, or the beginning of August, they may be cut down to within two or three eyes of the old wood. They should then be removed to a cold pit, and watered very sparingly; and when the young shoots are about an inch long, the plants ought to be turned out of the pots, and the soil having been nearly all shaken from the roots, and these shortened, they may be repotted in pots a size or two smaller. Some cultivators, after repotting, plunge the plants in a gentle bottom heat, or shut them up in a close frame till they take fresh root; others merely place them in a shady situation out of doors. In September, earlier or later in the month according to the season, the plants should be removed to the greenhouse, where they should receive the same treatment in respect to air and moisture, &c., as that recommended for young plants, and be repotted in October, and again in the end of January or in February. Mr. Cock, however, for large specimens, repots the plants, when cut down, in the same size as that in which they were previously growing, stops, in November, the plants intended to flower in May, and shifts the strongest plants in December or January, giving at the same time an increase of temperature to accelerate the rooting process, and placing about 4 feet apart, in order that the foliage may be fully exposed to the light. They are again shifted in March, and in both cases abundance of drainage is afforded. The plants intended for flowering in June are stopped in March, and those for July in the end of April.

Training out the shoots, in order to admit air and light to the middle of the plants, as well as to insure a regular and well-balanced growth, should be attended to at an early stage of growth, and as soon as the shoots are long enough, stakes should be inserted; but in doing this, care must be taken not to injure the roots. The other points of culture so obviously apply to all greenhouse plants, that it is scarcely necessary to repeat them here. They consist in giving air whenever the weather is favourable; keeping free from damp; exposing to light as much as possible, and with this view the plants should be placed so far apart as not to shade each other; repotting when necessary; checking shoots which are likely to produce an inequality of growth; and fumigating if green fly make its appearance.

The fancy Pelargoniums require the same treatment as the show varieties, except that they must have a higher temperature, and a more sandy soil, whilst, in the application of water, greater care must be exercised, otherwise there is danger of their suffering from damp. By propagating at different periods, stopping, and potting judiciously, and by the application of heat, they may be had in flower at any time. If struck in February they may be finally shifted for early blooming into 6 or 8 inch pots in October, and by striking in June, stopping, and giving a good shift in March, they will flower in July. After flowering, if repotted they will come into flower a second time.

Select List of Greenhouse Bulbs.

<i>Albuca altissima.</i>	<i>Lachenalia aurea.</i>
„ <i>major.</i>	„ <i>luteola.</i>
<i>Amaryllis Belladonna.</i>	„ <i>pendula.</i>
„ <i>blanda.</i>	„ <i>tricolor.</i>
„ <i>formosissima.</i>	<i>Lilium atrosanguineum.</i>
„ <i>vittata.</i>	„ <i>Brownei.</i>
„ „ <i>major.</i>	„ <i>eximium.</i>
<i>Anisanthus splendens.</i>	„ <i>japonicum.</i>
<i>Anomatheca cruenta.</i>	„ <i>lanceifolium album.</i>
<i>Bobartia aurantiaca.</i>	(Plate VII.)
<i>Bravoa geminiflora.</i>	„ „ <i>punctatum (do.)</i>
<i>Buphane ciliaris.</i>	„ „ <i>roseum.</i>
„ <i>toxicaria.</i>	„ „ <i>rubrum.</i>
<i>Chlidanthus fragrans.</i>	<i>Nerine curvifolia.</i>
<i>Clivia nobilis.</i>	„ <i>sarniensis.</i>
<i>Coburgia Josephinæ.</i>	„ <i>undulata.</i>
<i>Cyclamen africanum.</i>	<i>Ornithogalum aureum.</i>
„ <i>repandum.</i>	„ <i>miniatum.</i>
„ <i>persicum</i> and vars.	„ <i>revolutum.</i>
<i>Cyrtanthus angustifolius.</i>	<i>Pentlandia miniata.</i>
„ <i>obliquus.</i>	<i>Sparaxis grandiflora.</i>
„ <i>vittatus.</i>	„ <i>tricolor</i> and varieties.
<i>Ferraria undulata.</i>	„ <i>versicolor.</i>
<i>Gladiolus vars.</i>	<i>Sprekelia Cybister.</i>
<i>Hæmanthus coccineus.</i>	<i>Strumaria crispa.</i>
„ <i>pubescens.</i>	<i>Trichonema Bulbocodium.</i>
„ <i>punicus.</i>	<i>Triteleia uniflora.</i>
<i>Hesperantha cinnamomea.</i>	<i>Tritonia aurea.</i>
<i>Hippeastrum longiflorum.</i>	„ <i>crocata.</i>
<i>Ixia aulica.</i>	<i>Vallota purpurea.</i>
„ <i>conica.</i>	<i>Wachendorfia thyrsiflora.</i>
„ <i>erecta.</i>	<i>Watsonia Meriana.</i>
„ <i>maculata.</i>	„ <i>rosea.</i>
„ <i>patens.</i>	<i>Zephyranthes rosea.</i>

In the cultivation of greenhouse bulbous plants, especial attention should be directed to the production of foliage and to its maintenance in a healthy state, in order that it may efficiently perform its functions, and this, under favourable circumstances, it will continue to do until it naturally decay. It is by the leaves that the secretions are formed which become stored up in the bulbs, and from this store the plants derive a supply of nourishment, which in many cases enables them to burst rapidly into fresh growth and splendid bloom. It should be recollected that the principal materials for the flowers

of next year are formed by the leaves in the present, and stored up in the bulbs. In order to promote the growth of the leaves, the plants should have proper soil for their roots, which should likewise be supplied with moisture in proportion to the demand; and this will vary according to the temperature to which the plants are subjected, and the more or less active state of their vegetation. They should also be placed near the light and even under the influence of the sun's rays, otherwise the secretions cannot be properly elaborated. These are the principal points to be attended to, as regards the growth of the plants, and this being concluded, the bulbs have a period of rest. Previous, however, to their entering into a state of rest, it is essential that the bulbs should be well matured, or in other words, that their juices should be sufficiently inspissated. This is effected by diminishing the supply of moisture as soon as the leaves begin to decay; in fact they then evaporate less, and what was only a proper quantity when the plant was in a vigorous state of growth would then prove superabundant; therefore, for some time previous to the decay of the foliage, the supply of moisture should be gradually diminished, so that at the final decay of the leaves the bulbs may be in a dry state. Afterwards no water will be required till the bulbs again begin to grow. This gradual privation of moisture places the bulbs in a much better state for keeping, during their period of rest, as well as for again pushing vigorously, than if they were taken up when full of watery sap and then dried; for in this case the tissues of the bulbs must shrink in proportion to the water evaporated, and to the same extent water will be again absorbed when the bulbs come in contact with moisture, when again commencing their growth, and they are then apt to rot, or at least to produce imperfect flowers.

The soil in which greenhouse bulbs naturally grow, is in general an alluvial sandy loam, and soil of this description should therefore form the basis of the compost employed for their growth. Although naturally they may not be found growing in peat, yet when cultivated in pots a little of this is found to answer well, for its mechanical texture prevents the sandy loam from becoming too dense, as would otherwise be the case after repeated waterings. The plants enumerated in the preceding list, which belong to the natural orders Liliaceæ and Iridaceæ, will succeed in a mixture of three parts loam, two of sand, and one of peat; for the Amaryllis tribe, soil of a similar description may be employed, but the loam should be turfy.

Lilium lancifolium.—When plants of this species, or of its splendid varieties, two of the best of which are represented in Plate VII., have pushed about a foot above the soil, they are disposed to throw out roots from the stems for several inches above the surface. In cultivation advantage should be taken of this circumstance, by affording soil for such roots to strike into, and thus enable the plant to develop flowers in perfection, as well as to form good bulbs for the following season. A mixture of turfy loam, peat, and sand will suit the plant well. Some recommend a soil consisting of four parts turfy loam, one of rotten dung, and one of sand; but we have seen them growing exceedingly well in good sandy peat. In the end of December or beginning of January, let some 12 or 15-inch pots be well drained, and the drainage having been covered with some of the rougher portions of the compost, fill up with this to within 8 inches of the top, place three good bulbs on the soil, surround them with pure sand, and fill up with compost to within 3 inches of the top of the pot. No water will be required till the shoots appear

above ground, and then but sparingly at first. When 15 inches above the soil add compost to fill up the pot, place some pieces of rough peat round the rim and close to the stems, introducing some of the finer compost between the pieces. By this arrangement the roots protruding from the stem will obtain a large supply of nourishment, to enable the plant to develop its splendid flowers, and to form larger bulbs than if these side roots had been left to perish for want of soil. Some of the plants may be brought forward in gentle heat for decorating the greenhouse, whilst others may be placed out of doors in a warm situation for a succession. The bulbs will also flower well if planted in the open ground in February, taken up after flowering, and preserved in dry soil till spring. The remarks made as to placing soil to the stems, are also applicable to out-door plants.

Select List of Greenhouse Shrubs.

Abelia floribunda.	Citrus.
Abutilon insigne.	Clanthus Dampieri.
„ venosum.	„ puniceus.
Acacia armata.	Cneorum tricoccum.
„ dealbata.	Coleonema pulchra.
„ Drummondii.	„ tenuifolia.
„ floribunda.	Coronilla glauca.
„ grandis.	Corræa cardinalis (Plate XII.)
„ longiflora.	„ speciosa.
„ lophantha.	Crowea latifolia.
„ pubescens.	„ saligna.
„ verticillata.	Cupheas.
„ vestita.	Cytisus elegans.
Adamia versicolor.	„ racemosus.
Agathæa cœlestis.	Daphne odora.
Alonsoa linearis.	„ „ rubra.
Aloysia citriodora.	Daubentonia punicea.
Aphelaxis humilis.	Daviesia latifolia.
„ macrantha purpurea.	Desfontainia spinosa.
„ „ rosea.	Dillwynia floribunda.
Azaleas.	Diosma alba.
Bæckia virgata.	„ ovata.
Banksia serrata.	„ rubra.
Beaufortia decussata.	„ speciosa.
Bejaria myrtifolia.	Elæocarpus cyaneus.
„ racemosa.	Epacris.
Boronia denticulata.	Eriostemon buxifolium.
„ Drummondii.	Erythrina Crista-galli.
„ pinnata.	„ laurifolia.
„ serrulata.	Escallonia macrantha.
Bouvardias.	Euchilus obeordatus.
Brugmansia bicolor.	Eutaxia myrtifolia.
„ suaveolens.	Fuchsias.
Burchellia capensis.	Gardenia radicans.
Bursaria spinosa.	Gardouquia Hookeri.
Callistachys lanceolata.	Gastrolobium bilobum.
„ ovata.	„ villosum.
Callistemon lanceolatus.	Gazania rigens.
„ salignus.	Genetyllis tulipifera.
„ speciosus.	Genista canariensis.
Candollea cuneiformis.	Gnidia pinifolia.
Cantua dependens.	Gompholobium hirsutum.
Ceratostema longiflorum.	„ splendens (Pl. VIII.)
Cestrum aurantiacum.	„ venustum.
Chironia frutescens.	„ versicolor.
Chorozema cordata.	Goodia latifolia.
Chorozema Henchmanni.	Grevillea elegans (Pl. VIII.)
„ superba.	„ rosmarinifolia.
„ varia.	Habrochamnus corymbosus.



Drawn by M^r Withers

Eng^d by J. W. Lowry

1 *Gompholobium splendens*

2 *Hemiandra pungens*

3 *Grevillia elegans*

Habrothamnus eyaneus.	Pultenæa retusa.
„ elegans.	„ stricta.
„ fascicularis.	Rhododendron arboreum.
Helichrysum proliferum.	„ argenteum.
Heliotropes.	„ campanulatum.
Hemiantra pungens (Pl. VIII.)	„ Campbells.
Hibiscus heterophyllus.	„ campylocarpum.
„ phœniceus.	„ citrinum.
Hovea Celsii.	„ Dalhousiæ.
„ ilicifolia.	„ Edgworthii.
Indigofera australis.	„ Falconeri.
„ decora.	„ fulgens.
„ macrostachya.	„ glaucum.
Lachnæa purpurea.	„ Griffithianum
Lambertia formosa.	„ Aucklandii.
Lantanas.	„ Hookeri.
Leonotis Leonurus.	„ javanicum.
Leschenaultia biloba.	„ lanatum.
„ formosa.	„ Maddeni.
„ splendens.	„ niveum.
Leptodactylon californicum.	„ Nuttalli.
Leucadendron argenteum.	„ Thomsoni.
Linum trigynum.	„ Veitchianum.
Luculia gratissima.	Roella ciliata.
Melaleuca hypericifolia.	Salvia fulgens.
„ thymifolia.	„ gesneræiflora.
Meyenia creeta.	„ splendens.
Myrtus communis.	Sprengelia inearnata.
Nerium Oleander.	Statice arborea.
„ „ splendens.	„ Dicksoni.
Passerina grandiflora.	Styphelia tubiflora.
Philadelphus mexicanus.	Sutherlandia frutescens.
Pimelea decussata.	Swainsonia coronillæfolia.
„ Hendersoni.	„ galegifolia.
„ spectabilis.	„ Greyana.
Pittosporum coriaceum.	Templetonia glauca.
„ Tobira.	„ retusa.
Poinciana Gilliesii.	Telopea speciosissima.
„ pulcherrima.	Thibaudia floribunda.
Polygala cordifolia.	„ macrantha.
„ Dalmaisiana.	Tremandra verticillata
„ myrtifolia.	Tristania macrophylla.
„ speciosa.	Veronica Andersonii.
Protea cordata.	„ speciosa.
„ glomerata.	„ „ rubra.
„ longifolia.	Westringia rosmariniformis.

The species enumerated in the above list are too numerous for the culture of each to be separately entered into; indeed, with but few exceptions, they succeed with the general culture of greenhouse plants, and in a soil consisting of loam and peat, proper drainage being of course afforded. Banksia, Chorozeia, Candollea, Dillwynia, Daviesia, Euchilus, Grevillea, Indigofera, Leucadendron, Melaleuca, Polygala, Pultenæa, Roella, Statice, Swainsonia, Telopea, Thibaudia, Tremandra, and Tristania are best grown in peat, loam, and sand, or in sandy loam and peat, with the addition of some silver sand. A mixture of loam, leaf-mould, and sand is most suitable to Salvia and Cilanthus, whilst Pimeleas succeed best in peat, with the addition of a small proportion of loam. The following genera require similar treatment to that of Cape Heaths, and may therefore be associated with them in culture: Aphelexis, Azalea, Diosma, Epacris, Guidia, Helichrysum, Leschenaultia, Metrosideros, and Sprengelia, and Styphelia, to which may be added Boronia, Chorozeia, Crowea, Eriostemon, Hovea, and Templetonia.

Correa speciosa and *cardinalis* (Plate XII.) succeed well in a mixture of loam, peat, and sand, or in peat with a little fibrous loam, leaf-mould, and sand. They are propagated by cuttings inserted thinly in sand, over a mixture of peat and sand, covered with a bell-glass, and placed in very slight heat; or more readily by grafting or inarching on the common species, *C. alba* and *virens*. The more vigorous shoots ought to be stopped, in order that the plant may be the more closely furnished with flowers, without exhibiting any great length of naked shoots.

Luculia gratissima being a delightfully fragrant plant, deserves to be noticed at greater length than our limits will permit. Its propagation and culture were formerly considered very difficult, but Mr. Henderson, of Trentham, has grown it 16 feet high, and 39 feet in circumference. The cuttings should be taken from shoots of moderately firm growth about end of April, and inserted under a hand-glass, in pots of sandy peat with silver sand at top. Mr. Henderson places them in a vinery, and admits atmospheric moisture by tilting the glass for half an hour after syringing the house. The plants are potted off about the end of July, or as soon as they are fit, in three parts peat and one of light sandy loam, adding a little leaf-mould and silver sand. Then place in a pit without artificial heat, pinch the tops when a joint is made, shift again about the beginning of September, and in October remove to the greenhouse for the winter. The *Luculia* will succeed very well in a conservatory, but it requires to have the shoots judiciously shortened after flowering, otherwise, as in the case of a peach tree left unpruned, it will become naked almost to the extremities of the branches.

Gompholobium splendens (Plate VIII.) requires turfy peat, broken in small pieces and well mixed with about one-fourth of silver sand, and good drainage is essential. Plants of this elegant genus may be kept in a pit in summer, where their growth can be encouraged; and in watering, the whole of the soil in the pot should be thoroughly moistened, but care must be taken not to give water again till the soil is beginning to get dry. Pinch over-vigorous shoots before they get too strong, and cut out those that are weak and straggling before the plants start into fresh growth in spring.

The *Orange tree* is chiefly esteemed in this country for the beauty of its evergreen foliage, and the fragrance of its blossom. It is a native of Asia, but has long been extensively cultivated in the south of Europe. The soil and climate of the Azores is so favourable to it, that a single tree has there been known to produce in one year 20,000 oranges. The soil, we are informed by Mr. Wallace (*Jour. of Hort. Soc.*, vii. 238), is generally a friable loam, mixed with volcanic matter carried down by the rains of winter; it is for the most part of considerable depth, but many of the orange gardens are formed in places where there is little more than from 15 to 18 inches of soil above the shattered mass of rock and rubble. From this it may be inferred that good drainage is essential, especially in a climate which, like ours, is less favourable to the growth of this exotic than that of St. Michael's. There, according to Dove's tables, the mean temperature of winter is nearly 58°, that of spring 61°, of summer 68°, of autumn 62°, and the difference between summer and winter little more than 10°. Mr. Wallace states that he has sometimes seen the thermometer in January as low as 40°, but such occurrences were rare. It is known that the temperature of the earth, as far as the roots of trees penetrate in drained soil, differs little from that of

the air, and this being at St. Michael's 58° in winter, we may fairly conclude that the roots of the orange tree will there be seldom, if ever, subjected to a temperature below 55°. As the tops of trees, even in the most favourable situations, are exposed to greater variations of temperature than their roots, so they are better adapted than the latter for withstanding such vicissitudes. It will readily be admitted, that if the leaves and shoots are subjected for some time to a continuous cold of 32° they would be seriously injured, although they will bear with impunity, as in the Azores, an occasional extreme of 40°; but the roots are never, as regards temperature, in so low a medium. Therefore, we may conclude, that if the soil in which they are placed is so cold as 40°, the trees will suffer materially, and in proportion to the time they are in that condition. When the roots of orange trees are kept, not only too cold but also too wet, they either perish, or become so inert as to become unfit for performing their office. The consequence is, the trees exhibit signs of bad health, the leaves turning yellow, and frequently the only effectual remedy is to lop back the branches, shorten to some extent the roots, repot or place in a tub in fresh compost, and plunge in bottom heat, in order to start the plant into fresh growth. In most cases such proceedings would not be necessary, if the roots were not subjected to too much cold. The unthriving condition of orange trees is often attributed to the quality and not to the coldness of the soil, but in the majority of cases the latter is the true cause of the evil. No care bestowed on the top will counteract the consequences of a deficiency of warmth at the roots. What the lowest temperature of the soil should be, might be answered by referring to that of St. Michael's, about 55°, during the coldest period of the year. The minimum bottom heat may range between that and 45°, but preferably not below 50°, where a vigorous growth of the trees is intended to be maintained. This could easily be secured by lowering the tubs in a chamber, in which the above degree of heat would be steadily at command; and if the chamber were properly boarded over, the actual expense of maintaining such an amount of bottom heat would be very trifling, whilst the advantage, as regards the health and vigour of the trees, would be very great. Propagation is effected by any of the usual modes, but chiefly by budding and grafting seedling stocks of the lemon and citron. The soil should be of a porous nature: good turfy loam, with some peat, sand, and cow-dung forms a compost which answers very well. When making growth, manure water may be freely given, but in winter it is better withheld, and during that season water should be rather sparingly supplied.

The *Fuchsia* is propagated by seeds, cuttings, and occasionally by inarching, performed whilst the plants are in a growing state. The seeds should be sown in February or March, in pans of light rich mould, covered lightly, and placed in a slight bottom heat. When the young plants are an inch high they may be potted in small pots of loam, sand, and leaf-mould, and as soon as again established removed to a greenhouse or pit, where they should be shifted when necessary into larger pots; but stopping ought not to be practised, the objects being to obtain flowers as early as possible, and to observe the natural habit of the plant. Cuttings may be taken off any time in spring, summer, or autumn, but preferably in September for summer flowering, and in February or March for autumn show, the old plants being in this case placed in gentle heat to cause the production of shoots. These should be taken

off close to the old wood, when about 2 inches in length, and inserted in a light compost of loam, leaf-mould, and sand, surfaced with about half an inch of silver sand. They should then be placed in a gentle bottom heat, and covered with hand-glasses. When rooted they should be potted in 3-inch pots, and kept close till they have struck fresh root; afterwards they should be kept near the glass in a moist heat, ranging from 50° to 60°, or in a warm greenhouse, giving liberal shifts when necessary. Water ought to be freely supplied, and frequently overhead, and air admitted whenever the weather is favourable. Stopping the side shoots ought to be practised when these have made three or four joints, and if it is desired to make the plants grow bushy, the leader should be pinched soon after the first potting. As the plants advance, attention will have to be paid to staking, and for a month previous to flowering, weak liquid manure may be afforded two or three times a week. When in flower, the plants should have plenty of air; and when the bloom is over, it is advantageous to place them out of doors to ripen the wood. The soil, after the first potting, should consist of two parts loam, one of well decomposed cow-dung or old hotbed mould, and one of leaf-mould, with the addition of some sandy peat.

Succulents.—The natural habitats of these are various, some of them existing in dry sandy plains, fully exposed to the sun's rays, where every other kind of vegetation is parched up, others on naked volcanic rocks. They are of easy culture, many being propagated by seed, and most of them by cuttings, of which the cut surface should be allowed to get dry before insertion. Most of the free growing kinds succeed best in a mixture of rich sandy loam and peat or leaf-mould; others that are of slow growth require light sandy loam and brick rubbish, others again soil of this description, with the addition of peat. Of such as Cacti, for example, only the roots should reach soil of a nutritive character; above there should be a layer of sand, which ought to be kept dry in winter in order to prevent rot. And for the same reason, when the sand becomes charged with impurities it should be replaced with fresh. The pots ought to be well drained, and the materials decidedly porous. Little water is required by this class of plants, as compared with others of the same size; for their surface is adapted for expending but little by evaporation, and the demand for a supply of moisture from the roots is consequently small, hence the bulk of these organs likewise bears a small proportion to that of the rest of the plant. The following are some of the principal genera of succulent plants:—*Aloe*, *Crassula*, *Cactus*, *Mammillaria*, *Cereus*, *Opuntia*, *Euphyllium*, *Mesembryanthemum*, *Stapelia*, *Echeveria*, and *Kalosanthes*.

Select List of Greenhouse Climbers and Twiners.

<i>Bignonia</i> Cherere.	<i>Hardenbergia</i> longe-racemosa.
„ speciosa.	„ monophylla.
<i>Billardiera</i> longiflora	<i>Ipomœa</i> coccinea.
„ scandens.	„ Learii.
<i>Brachysema</i> latifolia.	„ Quamoclit.
<i>Clematis</i> azurea grandiflora.	„ rubro-cœrulea.
„ smilacifolia.	<i>Jasminum</i> azoricum.
„ indivisa lobata.	„ grandiflorum.
<i>Cobæa</i> scandens.	„ gracile.
<i>Crotalaria</i> elegans.	„ odoratissimum.
<i>Dolichos</i> lignosus.	„ pubescens.
<i>Eccremocarpos</i> scaber.	<i>Kennedy</i> Marryattæ.
<i>Hardenbergia</i> macrophylla.	„ rubicunda.

<i>Lapageria rosea</i> .	<i>Rhodochiton volubile</i> .
" " <i>albiflora</i> .	<i>Sollya Drummondii</i> .
<i>Lophospermum erubescens</i> .	" <i>linearis</i> .
" <i>scandens</i> .	<i>Tacsonia manicata</i> .
<i>Mandevilla suaveolens</i> .	" <i>mollissima</i> .
<i>Manettia bicolor</i> .	<i>Tecoma jasminoides</i> .
" <i>cordifolia</i> .	<i>Tropæolum azureum</i> .
<i>Maurandya Barclayana</i> .	" <i>brachycceras</i> .
" <i>semperflorens</i> .	" <i>Lobbianum</i> .
<i>Mitraria coccinea</i> .	" <i>pentaphyllum</i> .
<i>Passiflora alata</i> .	" <i>speciosum</i> .
" <i>kermesina</i> .	" <i>tricolorum</i> and
" <i>Loudoni</i> .	many fine hybrids.
" <i>quadrangularis</i> .	<i>Tweedia cærulea</i> .
<i>Philibertia grandiflora</i> .	<i>Zichya glabrata</i> .
<i>Plumbago capensis</i> .	" <i>inophylla</i> .

The above plants, with a few exceptions, succeed in equal parts of loam and peat, the ordinary culture of greenhouse plants being afforded. *Brachysemas*, *Hardenbergias*, *Kennedias*, *Philibertia*, *Tweedia cærulea*, and *Zichyas*, require soil of a lighter character, such as a mixture of sandy loam and peat, or loam, peat, and sand. The beautiful *Lapageria rosea* (Plate V.), constitutes one of the great ornaments of the conservatory in the end of summer and beginning of autumn, when covered with its large lily-like flowers. It succeeds well in any good soil sufficiently porous, and containing a portion of leaf-mould, but appears to prefer a mixture of loam, peat, and leaf-mould, with the addition of enough sharp sand to keep the whole open. The principal point in its management, is to give it a shady position and a liberal supply of moisture during the growing season.

Mandevilla suaveolens, another highly ornamental climber, should be planted out in a conservatory border, in a light loamy soil, mixed with some leaf-mould.

Select List of Herbaceous Greenhouse Perennials.

<i>Agapanthus umbellatus</i> .	<i>Mimulus glutinosus</i> .
<i>Anigozanthus coccineus</i> .	" <i>grandiflorus</i> .
<i>Aretotis tricolor</i> .	" <i>punicus</i> .
<i>Aristea capitata</i> .	<i>Nierembergia calycina</i> .
" <i>cyanea</i> .	" <i>gracilis</i> .
<i>Canarina Campanula</i> .	" <i>intermedia</i> .
<i>Canna indica</i> .	<i>Primula sinensis</i> varieties.
" <i>gigantea</i> .	<i>Salvia coccinea</i> .
" <i>Warscewiczii</i> .	" <i>ianthina</i> .
<i>Dianella cærulea</i> .	" <i>patens</i> .
<i>Impatiens platypetala</i> .	<i>Sisyrinchium bicolor</i> .
<i>Lobelia cardinalis</i> .	<i>Statice imbricata</i> .
" <i>fulgens</i> .	" <i>macrophylla</i> .
" <i>splendens</i> .	<i>Sireptocarpus Rexii</i> .

The *Cineraria* is unquestionably one of the most useful plants for producing a display in the greenhouse and conservatory during the winter and spring. The seed is best sown immediately after ripening, in June or July, in pots or pans filled with light soil, such as a mixture of loam, leaf-mould, and sand, covering slightly with fine mould; and placing the pots in a shady situation, where the soil must be kept moist. When the seedlings have formed rough leaves, they should be pricked out about 2 inches apart in store pots, and shut up in a frame till they have struck fresh root; afterwards, they ought to be placed out of doors, and as soon as strong enough, potted singly in 3-inch pots, shaded till again established, and then treated like plants from cuttings. A sowing

may likewise be made in March or April, in a cold frame. To obtain cuttings, the plants should, after flowering, be cut down nearly to the ground, placed in a shady border where they can be protected from heavy rain till they push shoots, when they may be potted or planted in a shady border of light rich soil. Abundance of shoots will soon be produced, and these having been taken off, should be inserted in soil like that recommended for sowing the seeds in, with a layer of silver sand at top. They should then be watered and shut up in a cold frame, and kept shaded for a few days till rooted, when they may be potted in 3-inch pots, kept close for two or three days, and then exposed more and more freely to the air.

The after culture consists in stopping, when the plants are about 3 inches high, shifting whenever the roots get to the sides of the pots, keeping near the glass, giving air whenever the weather is favourable, affording a liberal but, especially in winter, not an excessive supply of moisture, occasionally syringing overhead, guarding against frost, fumigating on the least appearance of the green fly, dusting with sulphur to prevent the attacks of the green fly, tying out the flower-stems, and removing very early blossoms. The soil employed for the repottings may consist of two parts of turfy loam, one of leaf-mould, and one of well-decomposed cow-dung, with the addition of some silver sand or sandy peat. This compost should be used unsifted, the coarse lumps only being broken down. As the plants progress towards flowering, weak liquid manure may be given with advantage, and when in bloom they may be removed to the greenhouse, where they must be well exposed to light, but shaded from strong sunshine. By propagating in spring, growing the plants rapidly, and allowing them to become pot-bound in autumn, a stock of plants for winter blooming will be secured.

Calceolarias are propagated by seeds and cuttings but the herbaceous kinds are generally increased by the former method. The seeds may be sown in July or August for summer flowering, and in March for succession, using pans filled with a mixture of loam, leaf-mould, and silver sand, the soil being sifted rather fine, and watered previous to sowing. The seeds should be scattered thinly, and very slightly covered with fine sandy soil; the pans may then be placed under hand-glasses, in a cool border if the sowing is made in summer, in a warm pit if in spring; and the soil should be kept moist by watering through a fine rose, or placing a piece of paper over it till the seeds vegetate. As soon as large enough to handle, the seedlings ought to be pricked out in store pots, from which they should be transferred to 3-inch pots as they increase in size, and placed in a cold pit when established. Cuttings of the shrubby sorts may be taken off in August or September for early flowering, in the end of February or in March for succession. They should be inserted in 3-inch pots filled with loam, leaf-mould, and sand, placed in a gentle bottom-heat, and kept rather close and shaded till struck, when they may be gradually hardened and placed in a pit or greenhouse. The herbaceous kinds, though generally raised from seed, may also be propagated by cuttings taken off after flowering. The plants being then cut down, are placed in a shady situation out of doors, and the soil in the pots is top-dressed with some fresh compost, so as to cover the base of the shoots. Cuttings, or rather rooted suckers, will thus be obtained, and if taken off, potted, and placed in bottom heat, will make established plants.

The after management of the plants, whether raised from seeds or cuttings, consists in keeping them near the glass in a moist atmosphere, with a minimum temperature of 45° to 50°; shifting whenever the pots get filled with roots, and always using plenty of drainage; giving plenty of air; watering frequently, both at root and overhead; fumigating; affording, as the plants advance towards flowering, an occasional application of liquid manure, and, lastly, supporting the flower-stems of such as require it. The soil employed for the various pottings may consist of two parts loam, one of leaf-mould, and one of cow-dung, or old hotbed mould, with the addition of some silver sand; this compost should be used in a rather rough state. To the above soil some peat may be added in the earlier stages of growth.

Select Annuals for the Greenhouse.

Acroclinium roseum.	Martynia fragrans.	
Brachycome iberidifolia.	Mesembryanthemum	tri-
Browallia demissa.	Mignonette.	[color.
" elata.	Nemophila insignis.	
Calandrinia discolor.	" maculata.	
" grandiflora.	Phlox Drummondii.	
" umbellata.	Portulaca grandiflora.	
Clintonia pulchella.	" splendens.	
Didiscus cæruleus.	" Thellusoni.	
Eucnide bartonioides.	" Thorburni.	
Gilia dianthoides, syn.	Rhodanthe Manglesii.	
Fenzlia dianthiflora.	Salpiglossis sinuata, varieties.	
Grammanthes gentianoides.	Schizanthus pinnatus.	
Linum grandiflorum rubrum.	" retusum.	
Lobelia Erinus speciosa.	Ten weeks stocks.	
" ramosa.	Tropæolums.	

The above should be sown in frames about the end of July, and again in August or September, for flowering in winter and spring; and if required in summer, a sowing may also be made in March. Balsams and cockscombs are very ornamental annuals for conservatory and greenhouse decoration in summer and autumn. *Balsams* should be sown in March for flowering in June, using pans or thumb-pots filled with light rich loamy soil. After sowing, the pots should be plunged in a bottom heat of 65° to 70°, and kept near the glass. When the young plants have made two good leaves, they should be potted rather deeply in 4 or 5-inch pots, and again plunged; afterward they will require to be shifted whenever the roots reach the sides of the pots, till in from 6 to 12-inch ones, according to the size which the plants are required to attain before blooming. This may be regulated by stopping more or less frequently, and giving liberal shifts, or the contrary. The soil for the various repottings may consist of fibrous loam and rotten cow-dung, or old hotbed dung, with the addition of some leaf-mould and sharp sand; and in every case the pots should be well drained. Throughout their growth, the plants should be kept near the glass, and at a sufficient distance apart; they must be liberally supplied with water at the root, as well as syringed overhead, morning and evening, in fine weather, and a day temperature of 65° to 70° should be maintained, air being freely admitted at every favourable opportunity. When the flower-buds appear, weak liquid manure may be given with advantage, and when coming into flower, the plants should be removed to the greenhouse. Very good specimens may be obtained for succession by sowing on a gentle hotbed in April and May, and growing the plants in a cool pit during the summer.

The *Cockscomb* requires nearly the same treatment as the balsam, except that it will bear with advantage a greater degree of heat. The seed may be sown any time from the beginning of May in pans of leaf-mould and sand, covering to the depth of $\frac{1}{4}$ inch, and watering through a fine rose. The pans should then be plunged in a cucumber bed, or one affording a similar amount of heat. As soon as the seedlings are strong enough, they must be potted in thumb-pots, using a mixture of loam and leaf-mould, with the addition of some silver sand, and placing the stem well down in the earth. A temperature of 60° by night and 70° by day should be maintained; plenty of air must be given, but not so as to lower the temperature and cause any sudden check to vegetation; water should be liberally supplied; the plants must be exposed as much as possible to light by placing them within a few inches of the glass, and at a sufficient distance from each other; finally, they must never be allowed to become pot-bound, unless it is desired to limit their size, in which case both the temperature and supply of water ought likewise to be diminished. If, on the contrary, very large specimens are the object, a soil consisting of loam, well-rotted manure, and leaf-mould should be employed, and a high temperature, liberal supply of water, and plenty of pot room must be afforded.

CHAPTER XXIV.

THE PLANT STOVE.

As this structure is destined for the culture of tropical plants, a much greater amount of heat must be at command than is necessary for the growth of greenhouse plants. These, for the most part, will not be seriously injured, if the temperature fall nearly to freezing; but no plant from within the tropics, unless from an elevated region, will bear so low a temperature with impunity. The foliage of some species of stove plants is of a firm dry texture, and composed of rigid fibres, and the leaves may not in this case exhibit immediately the effects of exposure to a low temperature, still the constitution of the plants will certainly be more or less injured, and sooner or later symptoms of ill health will be manifested. There are, of course, many plants from within the tropics for which a greenhouse temperature is quite sufficient, but the natural habitat of such is considerably above the level of the sea, and at still greater elevations even hardy plants are found. By stove plants, then, are to be understood such as are indigenous to the lower tropical regions, where a high average temperature invariably prevails, with but little variation throughout the year.

The following table is deduced from five

years' hourly observations at Singapore, in lat. $1^{\circ} 12' N.$, almost under the equator, in the Indian Archipelago, where a tropical vegetation so much abounds.

Extreme highest and lowest Temperatures at Singapore, lat. $1^{\circ} 12' N.$

	Hourly Mean.	In the Shade.		Highest in the Sun.	Lowest by Radiation.
		Highest.	Lowest.		
January....	78°	84°	74°	117°	66°
February..	78	84	75	119	60
March.....	79	85	76	114	65
April.....	80.5	85	76	111	70
May.....	81.3	86	72	111	72
June.....	81.6	86	75	111	70
July.....	82.5	86	76	113	70
August....	80.4	85	76	112	69
September.	81.3	85	77	115	63
October....	80.8	85	76	114	66
November..	80.2	85	75	115	69
December..	79.5	84	75	115	68

From the above it appears that the mean of the whole year, according to hourly observations, was $80^{\circ} 38$, that the thermometer in the shade never rose more than 6° , nor fell at any time more than 8° below 80° . The extreme range in the shade was therefore between 86° and 72° . Exposed, however, to the effects of radiation, the thermometer fell as low as 60° ; hence we may conclude that tropical plants, from near the level of the sea and almost under the line, will bear to be occasionally as low as 60° . According to the above natural data, the temperature of a house for tropical plants should not rise above 86° , nor fall below 65° ; but experience proves that if allowed to sink as low as 60° in winter, it is better than to keep it higher by the application of a great amount of artificial heat. A high temperature by sun heat should be prevented, by giving air gradually, for it is bad management to allow the thermometer to rise too high and then lower it suddenly, by the admission of a current of air.

In giving air to stove plants, it should be recollected that they are much more susceptible of injury from draughts of cold air than greenhouse plants are; for some of them in their native climates, as for instance those indigenous to the Indian Archipelago, are subject to but little variation in the shade throughout the whole year, the range being not more than 14° between the highest extreme in the hottest and the lowest extreme in the coldest period, whilst the variation of temperature in any twenty-four consecutive hours rarely exceeds 6° . This being the case, it will readily

be admitted, that to let in a rush of cold air at perhaps 40° to a house at 80° , must act very unfavourably on the plants within it. Instead of admitting a certain amount of external air at 40° , it would be better to allow double the quantity to pass in at 60° ; for whilst this would produce the same effect in keeping down the internal temperature, any draught of air that might come in contact with the plants would be 20° warmer. It is therefore desirable that the external air should not only be admitted through screens to prevent sweeping draughts, but also that, when very cold, it should be warmed, in order to reduce the disparity between its temperature and that of the air of the house. It would be well to adopt some means of warming the air to at least 55° , before it is employed for the ventilation of the stove. Where such means are not at command, shading during intense sunshine is advisable, for whatever heat a plant exposed to the sun may bear, the shaded parts should not be subjected to a temperature exceeding about 85° , as indicated by a thermometer inside the house, but shaded from the sun's rays.

Moisture.—The supply of water for the roots must of course be regulated according to the demand, and plants growing in the same house can be easily suited in this respect; but the proper degree of atmospheric moisture cannot be insured to all stove plants if grown in one compartment, for some of them are from dry and others from moist situations. For both kinds of plants the same temperature may be suitable, but in order to afford the requisite amount of atmospheric moisture to each, two houses or compartments are necessary. If instead of two structures, one a dry and the other a moist stove, only one can be afforded, that one, as regards temperature, will be equally suitable for tropical plants, from either dry or moist situations, and may be heated by one apparatus, but it should be divided into two compartments by a glazed partition, so that the air of the one may be kept dry and that of the other moist. It would indeed be very advantageous if three divisions were formed, and arrangements made by which a temperature, intermediate between that of the stove and the greenhouse, could be maintained.

Culture.—The cultivation of stove plants differs little from that of greenhouse plants, excepting in respect to temperature. With regard to soil, most stove plants succeed in a mixture of rich fibrous loam and peat, and to

this some clean sand ought to be added, if there is not enough in the loam to keep it sufficiently open after its fibrous part becomes wasted. Leaf-mould, if good and free of fungus, may also be employed. For plants that are not disposed to grow over-luxuriantly, a little rotten cow-dung mixed with the soil will prove beneficial, and to such plants rather clear manure water may be given occasionally.

The plants should be encouraged to make their principal growth in summer, the period when light is most abundant. In winter, on the contrary, when light is deficient, vegetation must be kept going on, but the less growth that is made during that season the better. The plants should then be brought as nearly as possible to a state of rest, not, however, in consequence of being paralyzed by too great a reduction of temperature, but by a safe partial lowering of it, together with as limited a supply of moisture as the plants will bear. But, previous to this, the quantity of moisture in the air of the house should be gradually diminished, and sun and air rather freely admitted, in order to render firm the summer growth.

Plants that require pruning should have that operation performed before they start into fresh growth; little cutting will, however, be necessary, if due attention is paid to stopping and training as growth proceeds. As soon as the plants are about to make fresh growth is generally the best time for shifting those that require fresh soil or more pot room for their roots.

Select List of Stove Plants.

Achimenes, numerous vars.	Begonia incarnata.
Adhatoda cydoniifolia.	" manicata.
Æchmea fulgens.	" nitida.
Æschynanthus fulgens.	" odorata.
" longiflorus.	" parviflora.
" speciosus.	" prestoniensis.
" splendidus.	" urophylla.
Allamanda neriifolia.	Bilbergia Morelliana.
Alloplectus speciosus.	" splendida.
Amherstia nobilis.	" thyrsoides.
Angelonia salicariæfolia.	" Wetherelli.
Aphelandra aurantiaca.	Brownea grandiceps.
" cristata.	Brunfelsia americana.
" fulgens.	Centradenia rosea.
" pulcherrima.	Chirita Moonii.
Ardisia crenata.	" zeylanica.
" paniculata.	Clerodendron fragrans.
Asystasia coromandeliana.	" infortunatum.
Begonia albo coccinea.	" paniculatum.
" cinnabarina.	" speciosissimum.
" coccinea.	" squamatum.
" fuchsoides.	Coleus Blumei.
" Griffithii.	Columnea scandens.
" hydrocotylæfolia.	Coutarea speciosa.

Crossandra undulæfolia.	Justicia rosea.
Cyrtoceras reflexum.	" speciosa.
Dichorisandra picta.	Lagerstroemia indica.
" thyrsiflora.	Lemonia spectabilis.
Duranta Plum'eri.	Marica cærulea.
Eranthemum nervosum.	Medinilla magnifica.
" pulchellum.	Melastoma malabathricum.
" strictum.	Mimosa pudica.
Euphorbia jacquiniiflora.	Murraya exotica.
" splendens.	Mussaenda frondosa.
Franciscea acuminata.	Pentas carnea.
" calycina.	Phrynium sanguineum.
" eximia.	Pitcairnia flammea.
" Hopeana.	" staminea.
" hydrangæformis.	Pleroma Kunthianum.
Gardenia florida.	Plumbago occidentalis.
" " Fortuniana.	" rosea.
" radicans.	Plumiera Jamesoni.
" Stanleyana.	" rubra.
Geissomeria longiflora.	Poinciana pulcherrima.
Gesnera cinnabarina.	Poinsettia pulcherrima.
" Donkelaariana.	Porphyrocoma lanceolata.
" Mieliezii.	Portlandia grandiflora.
" zebrina, &c.	Rivina humilis.
Gloxinias.	Rondeletia anomala.
Goldfussia anisophylla.	" speciosa major.
Guzmania tricolor.	Ruellia formosa.
Hedychium angustifolium.	" longifolia.
" Gardnerianum.	" macrophylla.
Heliconia angustifolia.	" ovata.
" pulverulenta.	Russelia juncea.
Hibiscus Rosa sinensis.	Sciadocalyx Warszewiczii.
" splendens.	Sinningia guttata.
Hindsia violacea.	" Youngiana.
Howardia Caracasensis.	Siphocampylus microstoma.
Hoya bella.	Sonerila margaritacea.
Inga pulcherrima.	Streitzia reginæ.
Ixora coccinea.	Tabernaemontana coronaria
" crocata.	flore pleno.
" Griffithii.	Torenia asiatica.
" javanica.	Thyrsacanthus Schomburg-
" odorata.	kiana.
" rosea.	Vinca alba.
Jatropha panduræfolia.	" rosea.
Justicia carnea.	Vriesia psittacina rubro-
" coccinea.	bracteata.
" picta.	" splendens.

In addition to the above there is a great variety of stove plants remarkable for the beauty and variegation of their foliage, such as Achimenes cupreata, Æchmea fulgens discolor, Alloplectus speciosus, Aphelandra Leopoldi, Begonia Griffithii, splendida argentea, xanthina pictaefolia, zebrina, Caladium bicolor, Cissus discolor, Coleus Blumei, Croton pictum, variegatum, Dracæna ferrea, terminalis, Gesnera zebrina, Maranta zebrina, Warszewiczii, Sonerila margaritacea, Tradescantia discolor, &c. Some of these should exist in every good collection.

Select List of Stove Climbers.

Allamanda cathartica.	Allamanda Schottii.
" grandiflora.	Beaumontia grandiflora.



Drawn by M^r J. E. Smith

Engraved by Tho^s Luck

STOVE PLANTS.

1 *Allamanda cathartica*. 2 *Stephanotis floribunda*.



Drawn by M^r Withers

Eng^d by J. W. Lowry

1 *Thyrsacanthus Schomburgkianus*. 2 *Dendrobium nobile*

<i>Bignonia Chamberlaynii</i> .	<i>Mauettia bicolor</i> .
„ <i>venusta</i> .	„ <i>cordifolia</i> .
<i>Cissus discolor</i> .	<i>Passiflora alata</i> .
<i>Clerodendron splendens</i> .	„ <i>kermesina</i> .
<i>Combretum purpureum</i> .	„ <i>quadrangularis</i> .
<i>Dipladenia atropurpurea</i> .	„ <i>racemosa</i> .
„ <i>crassinoda</i> .	<i>Pergularia odoratissima</i> .
„ <i>magnifica</i> .	<i>Petrea volubilis</i> .
„ <i>splendens</i> .	<i>Physianthus auricomus</i> .
<i>Eclites suberecta</i> .	<i>Quisqualis indica</i> .
<i>Hexacentris mysorensis</i> .	<i>Raphistemma pulchellum</i> .
„ „	<i>lutea</i> .
<i>Hoya carnosa</i> .	<i>Solandra grandiflora</i> .
„ <i>imperialis</i> .	<i>Stephanotis floribunda</i> .
<i>Ipomoea Horsfalliæ</i> .	<i>Thunbergia alata</i> and varie-
„ <i>insignis</i> .	ties.
„ <i>rubro-cærulea</i> .	„ <i>grandiflora</i> .
<i>Jasminum Sambac</i> .	„ <i>Harrisii</i> .
	„ <i>laurifolia</i> .

The plants enumerated in the preceding lists, succeed for the most part with the ordinary treatment of stove plants, and, with but few exceptions, should be grown in a compost of rich friable loam and peat. We shall therefore only make a few remarks on those requiring a particular mode of treatment.

Achimenes.—Propagation is effected by small tubers of the previous year's growth, and by cuttings of the shoots in bottom heat. Shake the earth from the tubers and plant in pots or pans of leaf-mould, sand, and peat, with the addition of a little well-decomposed cow-dung; start them in bottom heat in February for flowering in June, and in succession for flowering till winter. Transplant when about two inches high into pans or pots, placing several in each, and shift when these are getting full of roots. After flowering, the plants should be kept growing till the foliage decays, in order to perfect the tubers; the pans must then be placed on a shelf, and the soil kept dry till the tubers are required for planting. *Gesneras* require similar treatment.

Echeuca and *Æschynanthus*.—Fibrous sandy peat in a pot or suspended in a basket, but the former is preferable. Attend to keeping them duly supplied with moisture.

Allamanda.—Turfy loam and peat, with some well-decomposed leaf-mould and silver sand. *A. neriifolia* is very ornamental when trained in a rather dwarf compact form, and by stopping the shoots at the second or third joint a succession of flowers will be produced for several months. *A. Schottii* (Plate IX.) and *cathartica* are beautiful climbers; they should be cut well back early in spring, and started with plenty of heat and moisture. If there is sufficient space for their full extension, manure water may be given during the season of growth and flowering.

Begonias require turfy loam, peat, leaf-mould, and sand, with a temperature of 55° to 65° for flowering, but in order to maintain the plants long in bloom, they may be kept in a temperature of 45° to 50°.

Clerodendrons succeed in equal parts of turfy loam, peat, and rotten cow-dung, with the addition of charcoal and sand to insure drainage. Place the plants in a pit in the beginning of March, plunge in bottom heat, shift when necessary, and finally into 13-inch pots towards the end of April; and when the flowers expand remove to the coolest part of a stove, or to an intermediate house.

Keep nearly dry in winter, and cut back to a few eyes, repot, and start in spring as before.

Francisceas.—Sandy loam, turfy peat, and leaf-mould; plenty of heat and moisture whilst growing, and a moderate temperature, and rather dry atmosphere after the wood is ripened. They should be pruned rather closely previous to starting.

Gardenias.—Propagated by cuttings of the half-ripened shoots, in sandy peat under a bell-glass; pot off in 3-inch pots, and plunge in bottom heat. A suitable compost for the plants consists of loam, peat, and sand, with a little well-decomposed cow-dung. In the second season place the plant, early in spring, in a pit with a good bottom heat. When the flowers begin to appear the plants may be removed to the greenhouse, and after flowering they should be pruned and kept well exposed to light and air, with less moisture, till the wood becomes firm. The temperature must then be gradually reduced to 50° or 55° in winter.

Gloxinias are propagated by cuttings or by leaves, and require a mixture of loam, peat, leaf-mould, and sand, with a moist atmosphere, and a rather sparing supply of water at the root. After flowering keep in any dry place.

Ixora.—Turfy peat and sand; half plunge in a dung pit in February, and stop the shoots; shift in May, and finally in the middle of July, after which the plants should be allowed to grow without stopping, in order that they may gain strength and make roots.

Stephanotis floribunda (Plate IX.)—Equal parts of turfy loam and peat, with sand to insure porosity, will form a good compost for this beautiful climber. As it makes rapid growth, attention must be paid to shifting before the roots get over-crowded; finally it may occupy a 15-inch pot. As growth proceeds the shoots must be regulated by pruning and training, and it will soon cover a large extent of trellis or rafter. Towards the end of the season less moisture should be supplied, in order to render the wood more firm.

Thysacanthus Schomburgkiana (Plate XI.)—This very useful plant for winter flowering is propagated by cuttings in peat and sand, under a bell-glass. They should be struck early in spring, kept near the glass in a pit, in gentle bottom heat, and shifted on. Train the centre shoot upright, leaving the side ones to assume their natural pendulous direction; by these means handsome plants will be produced in the course of the summer, for flowering in winter and spring. The soil should consist of turfy loam, peat, and sand, with a little decomposed cow-dung.

Select List of Orchids.

Those marked *b.* are grown in baskets with sphagnum and potsherds, those marked *bl.* are grown on blocks of wood.

<i>Aerides affine, b.</i>	<i>Cattleya labiata.</i>
„ <i>cristatum, b.</i>	„ <i>Mossie.</i>
„ <i>Fieldingi, b.</i>	„ <i>Skinneri.</i>
„ <i>maculosum, b.</i>	<i>Chysis bractescens.</i>
„ <i>odoratum, b.</i>	<i>Cælia macrostachya.</i>
„ <i>quinquevulnera, b.</i>	<i>Cælogyne cristata, bl.</i>
„ <i>virens, b.</i>	„ <i>Wallichiana.</i>
<i>Angræcum eburneum, b.</i>	<i>Cymbidium eburneum.</i>
<i>Anguloa Clowesii.</i>	„ <i>Mastersii.</i>
<i>Barkeria spectabilis, bl.</i>	<i>Cypripedium barbatum ma-</i>
„ <i>Skinneri, bl.</i>	„ <i>caudatum. [jus.</i>
<i>Calanthe veratrifolia.</i>	„ <i>villosum.</i>
<i>Cattleya Acklandiæ.</i>	<i>Dendrobium Cambridge-</i>
„ <i>crispa.</i>	<i>anum, b.</i>

<i>Dendrobium Dalhousiean-</i>	<i>Odontoglossum pulchellum</i> , <i>bl.</i>
„ <i>densiflorum</i> , <i>b.</i> [um, <i>b.</i>	<i>Oncidium Barkeri.</i>
„ <i>Devonianum</i> , <i>b.</i>	„ <i>bicolor</i> , <i>bl.</i>
„ <i>Farmeri.</i>	„ <i>crispum</i> , <i>bl.</i>
„ <i>Falconeri.</i>	„ <i>flexuosum majus</i> , <i>b.</i>
„ <i>formosum.</i>	„ <i>Lanceanum</i> , <i>b.</i>
„ <i>macrophyllum</i> , <i>b.</i>	„ <i>Papilio.</i>
„ <i>nobile</i> (Plate XI.)	<i>Peristena alata.</i>
„ <i>Pierardi</i> , <i>b.</i>	<i>Phaius albus.</i>
„ <i>Wallichii.</i>	<i>Phalænopsis amabilis</i> , <i>bl.</i>
<i>Epidendrum cinnabarinum.</i>	„ <i>grandiflora</i> , <i>bl.</i>
„ <i>Hanburii.</i>	(Plate XII.)
„ <i>macrochilum.</i>	<i>Saccolabium Blumei</i> , <i>b.</i>
„ „ <i>roseum.</i>	„ <i>guttatum</i> , <i>b.</i>
„ <i>verrucosum.</i>	„ <i>miniatum</i> , <i>b.</i>
„ <i>vitellinum</i> , <i>b.</i>	<i>Sobralia macrantha splendens.</i>
<i>Ælia anceps</i> , <i>b.</i>	
„ <i>autumnalis</i> , <i>b.</i>	<i>Sophronitis grandiflora</i> , <i>bl.</i>
„ <i>cinnabarina.</i>	<i>Stanhopea grandiflora</i> , <i>b.</i>
„ <i>majalis</i> , <i>b.</i>	„ <i>insignis</i> , <i>b.</i>
„ <i>purpurata</i> , <i>b.</i>	„ <i>tigrina</i> , <i>b.</i>
„ <i>superbiens</i> , <i>b.</i>	<i>Trichopilia coccinea</i> , <i>b.</i>
<i>Leptotes bicolor</i> , <i>b.</i>	„ <i>suavis.</i>
<i>Lycaste Skinneri.</i>	„ <i>tortilis.</i>
<i>Miltonia spectabilis</i>	<i>Vanda cœrulea</i> , <i>b.</i>
(Plate X.)	„ <i>gigantea</i> , <i>b.</i>
<i>Odontoglossum citrosimum</i> , <i>bl.</i>	„ <i>Roxburghi</i> , <i>b.</i>
„ <i>grande</i> , <i>bl.</i>	„ <i>suavis</i> , <i>b.</i>
„ <i>leucochi</i> -	„ <i>teres</i> , <i>b.</i>
„ <i>lum</i> , <i>bl.</i>	„ <i>tricolor</i> , <i>b.</i> (Plate X.)
„ <i>membrana-</i>	<i>Zygopetalum Mackayi.</i>
„ <i>ceum</i> , <i>bl.</i>	„ <i>rostratum.</i>

Culture.—Some species are naturally disposed to grow continually, but the generality have a period of growth and one of comparative rest. During their season of growth all kinds require more heat and moisture than when at rest. Mexican species on the average require a temperature about 10° lower than those from the East Indies and other very hot parts of the world. The direct rays of the sun must, however, be guarded against, for an amount of these that would not injure the leaves of the vine would totally destroy those of even tropical orchids. But, although shading from the direct rays is necessary, abundance of diffused light is equally essential, more especially when the plants are making fresh growth; and they should therefore not be encouraged to do this in the winter season, when light is deficient.

Exotic orchids have been obtained from

parts of the world differing considerably as regards climate, and to suit these properly more than one house would be necessary, or one might be divided into two compartments, one hot and the other comparatively cool. In the warm compartment most of those from the East Indies should be kept; in the other, which may be generally 10° lower, the species requiring an intermediate degree of heat between the stove and greenhouse may be accommodated. No tropical plant requires a higher maximum temperature in the shade than 86°, for it will be seen by referring to the Singapore table, that almost under the line that temperature is seldom exceeded. Indeed, 80° by day and 72° by night will produce as rapid a growth as will be consistent with the deficiency of light, which in our climate we occasionally experience; 90° by the sun heat should be the extreme highest, but if the thermometer indicates 85°, when its bulb is completely shaded from the sun's rays, that is quite as high as is desirable. If the warmest orchid house is regulated according to the above, and plenty of moisture afforded, the plants will be in a favourable condition for making their growths. And this is best effected, as already observed, when light is abundant, during the months of May, June, July, and August. After this the temperature and supply of moisture should be gradually diminished, but air and sunlight as freely admitted as circumstances will permit, in order to firm the tissues of the stems and pseudobulbs. When, by the above means, the plants are brought into as dormant a state as possible in winter, the temperature of the warmest house during that period may be lowered to 65° by night, and 70° by day. With regard to the cooler house or compartment, it may be 5° lower than the other during the growing period, or 75° maximum and 67° minimum; and when the plants are at rest the maximum may be 60° and the minimum 50° to 55°. In all cases, when the plants are observed to be otherwise than in a thriving state, their condition, either as regards heat, moisture, or soil, should be altered without delay.



drawn by Miss Withers

Eng^d by J.W. Lowry

1 *Vanda tricolor* var.

3 *Vanda insignis* Helvcola

2 " *formosa*

4 *Miltonia spectabilis*



Drawn by M^{rs} Withers

Engr^d by J.W. Lowry

1. *Phalenopsis grandiflora*. 2. *Correa cardinalis*.

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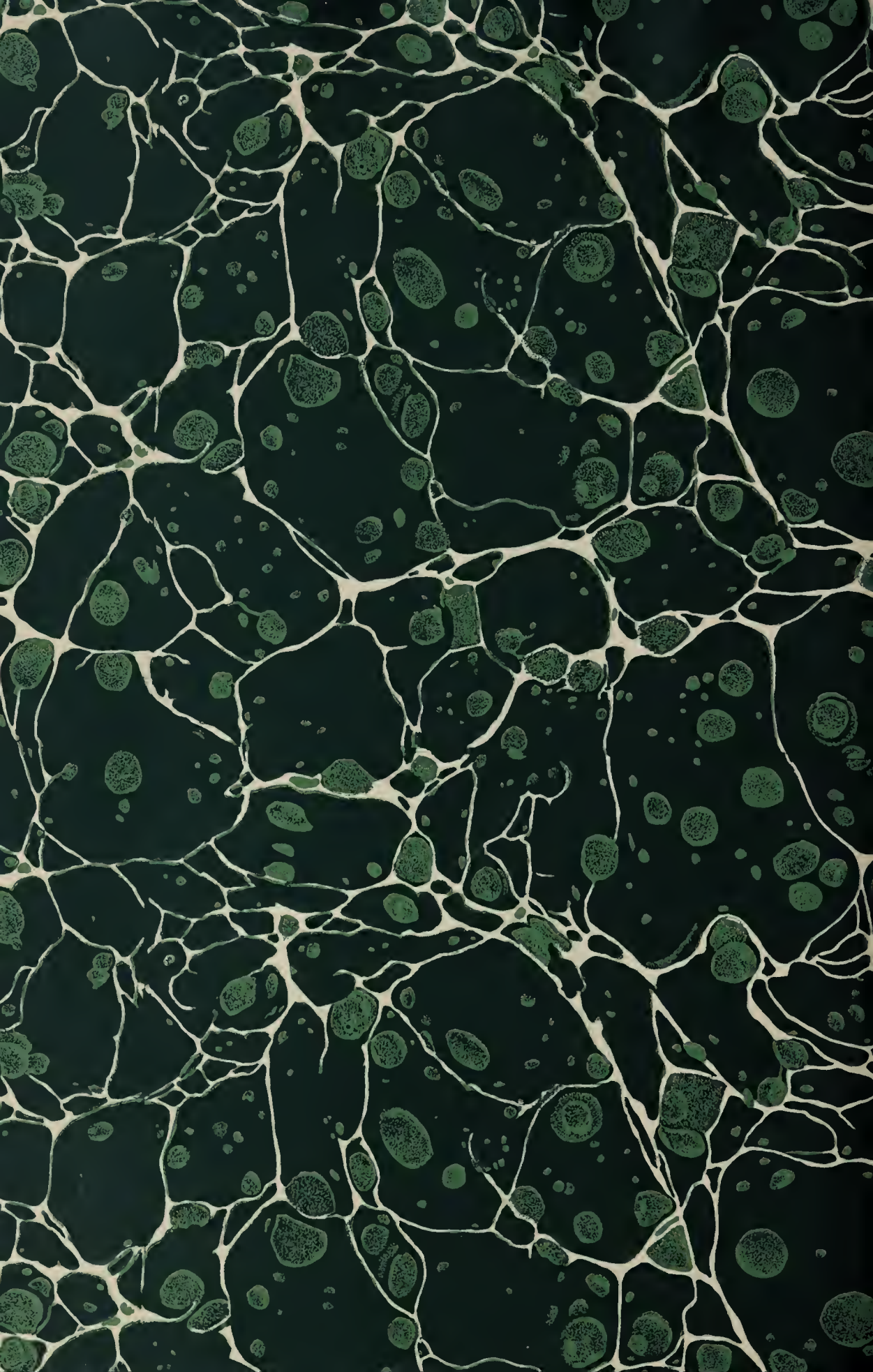
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